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Título de la tesis:

Three Essays on the Effect of Expropriation Risk on Private Investment

Autora: Diana Constanza Restrepo Ochoa

Directores: Ricardo Correia
Juan Ignacio Peña

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Firma del Tribunal Calificador:

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Henry Ford once said, "Life is a series of experiences, each one of which makes us bigger, even though sometimes it is hard to realize this".

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Reconocimientos

Henry Ford dijo alguna vez, "La vida es una serie de experiencias, cada una de las cuales nos hace más grandes, aunque a veces no es fácil darse cuenta de esto".

No encuentro palabras para expresar cuán profundamente agradecida estoy con todos aquellos que, de una forma u otra, me ayudaron a superar el gran reto que supone hacer un Doctorado. El apoyo afectuoso de mi familia y mis amigos y la dedicación de mis asesores durante esta etapa fueron decisivos para lograrlo.

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Summary

This thesis studies the effect of expropriation risk on private investment. The first chapter uses a Real Options model to assess the importance of private provision and the impact of expropriation risk on investment timing, project value, governmental costs and social welfare. The model is built considering two types of businesses (essential and non-essential) and two stages (operating and investment opportunities) and answers questions regarding three main topics: the firm's reaction to expropriation risk, the government drivers to expropriate, and the costs expropriation generates in terms of welfare. The results show that the firm makes suboptimal investment decisions in the presence of expropriation risk. Once reputational costs of expropriation are endogenized, the government's decision regarding the level of political risk will largely depend on the type of business. However, in terms of welfare, it is never optimal to expropriate.

The second chapter addresses the question of how different fiscal incentives affect private investment in a context of expropriation risk. This is done by extending the analysis of the first chapter: a real options model where the firm's decisions and the government's decision to expropriate can interact. We find that incentives implying a higher level of expropriation risk are associated with a lower value of the investment opportunity of the firm, even though there is an improvement in the operating firm's results. Therefore, although the optimal decision for the economy as a whole is to offer a safe political environment for investors, if expropriation risk cannot be taken out of the picture, fiscal incentives that do not exacerbate political risk will be the best option to attract investment.

Finally, the third chapter measures the impact of warnings of expropriation and of forced divestments of private property on the stock prices of the parent company. It uses a unique database of 116 events in 12 countries from 2005 to 2013. Results show significant negative effects on the stock prices of different kinds of warnings; the largest effect is when the warning takes the form of a transitory permit revocation. In the case of forced divestments, there is significant negative impact when a permit is permanently revoked. However, nationalizations seem to generate a positive market reaction.

Resumen

Esta tesis estudia el efecto del riesgo de expropiación en la inversión privada. El primer capítulo utiliza un modelo de Opciones Reales para determinar la importancia de la provisión privada y el impacto del riesgo de expropiación en la elección del momento oportuno para invertir, el valor del proyecto, los costos gubernamentales y el bienestar social. El modelo se construye considerando dos tipos de negocios (esencial y no-esencial) y dos etapas (operativa e inversión) y responde preguntas relacionadas con tres temas principales: la reacción de la firma al riesgo de expropiación, los motivos del gobierno para expropiar, y los costos que genera la expropiación en términos de bienestar. Los resultados muestran que las decisiones de inversión de la firma son subóptimas en presencia de riesgo de expropiación. Una vez se han endogenizado los costos de reputación, la decisión del gobierno con respecto al nivel de riesgo político dependerá en gran medida del tipo de negocio. Sin embargo, en términos de bienestar, nunca es óptimo expropiar.

El segundo capítulo se enfoca en la pregunta de cómo diferentes incentivos fiscales afectan la inversión privada en un contexto de riesgo de expropiación. Esto se realiza extendiendo el análisis del primer capítulo: un modelo de opciones reales donde las decisiones de la firma interactúan con la decisión de expropiar del gobierno. El modelo muestra que que los incentivos fiscales que implican un nivel mayor de riesgo de expropiación están asociados con un menor valor de la oportunidad de inversión de la firma, aunque hay una mejoría en los resultados operativos. Por lo tanto, aunque la decisión óptima para la economía en general es ofrecer un ambiente político libre de riesgo, si la expropiación no se puede eliminar completamente, los incentivos fiscales que no incrementen el riesgo político serán la mejor opción para atraer a la inversión privada.

Finalmente, el tecer capítulo mide el impacto de las advertencias de expropiación y de las desinversiones forzosas de propiedad privada sobre los precios de la acción de la casa matriz. Para ello se utiliza una base de datos única de 116 eventos en 12 países, entre 2005 y 2013. Los resultados muestran efectos significativos adversos en los precios de las acciones para diferentes tipos de advertencias, siendo las revocaciones transitorias de permisos de operación las que generan la mayor reacción del mercado. En el caso de las desinversiones forzosas, existe un impacto negativo significativo cuando un permiso de operación es revocado permanentemente. Sin embargo, las nacionalizaciones parecen generar una reacción positiva del mercado.

Chapter 1

Introduction

Political risk can be defined as the risk that actions of agents pursuing political objectives affect the value of assets of agents pursuing economic objectives (Correia et al., 2012). Given its ample definition, the expressions of political risk are generally classified into four main categories (Root, 1972; Baas, 2010). First, *violence risk* is associated with violent acts with a political origin that lead to the impairment of firms' assets or render businesses non-operational (Baas, 2010). Second, the uncertainty of being able to repatriate resources from the host to the home country is categorized as *transfer risk* (Baas, 2010; Tomz and Wright, 2010; Clague et al., 1996). Third, policies, governmental procedures or regulations that affect the results of investment, but not its ownership, constitute *operational political risk* (Root, 1972; Jensen, 2003). And fourth, when there is a possibility to be deprived of property or control rights of a facility in the host country, political risk is labeled *expropriation risk* (Truitt, 1970; Kobrin, 1980; Hajzler, 2012).

Since the many expressions of political risk can severely influence the value of investments in host countries, it is only reasonable to expect that financial markets be affected by political variables. For instance, a lower level of political risk in a host country seems to lead to higher stock returns (Lehkonen and Heimonen, 2015) and to a smaller cost of debt for firms operating there (Qi et al., 2010); democratic regimes are associated with larger FDI –Foreign Direct Investment– inflows (Jensen, 2003), and democratic presidencies tend to generate larger excess returns in the stock market than republican presidencies (Santa-Clara and Valkanov, 2003). Political events also cause financial markets to react. At the market level, the election of a candidate that is considered market-friendly has been shown to positively impact stock market returns (Jensen and Schmith, 2005). At the firm level, authorization of U.S. backed-coups (Dube et al., 2011) and announcements of political appointments in the U.S. (Luechinger and Moser, 2014) seem to induce positive abnormal returns for the implicated firms.

This thesis forms a part of the literature exploring the relationship between political risk and private investment, with a focus on *expropriation risk*. In general, expropriations should have a negative effect on firms' value. From the perspective of a parent firm with a subsidiary at risk of being expropriated, value losses come from several fronts. On the one hand, it experiences the loss of future cash flows generated by the subsidiary. On the other hand, it is very unlikely that the parent firm obtains a fair compensation for the expropriated firm; should it be granted amicably by the host government, it will probably be below fair value, but in most cases it has to be pursued in international arbitration –with no guarantee of getting it. From the subsidiary's perspective, the loss of value due to expropriation occurs if the public administration is relatively less efficient than private agents, which seems to be the rule (Shleifer, 1998; Stiglitz, 2000). In fact, Gao and Kling (2008) show that nationalizations in China are associated with negative abnormal returns on the stock prices of nationalized firms.

Nevertheless, it is not only firms that face costs related with expropriation, governments can also experience these costs in several forms. First, the government's relative inefficiency may be increased by the loss of intangible assets, like know-how and managerial skills (e.g., Raff (1992)), or by retaliation of international investors in financial or commodities markets –the case of the

Argentinian government facing at least a 20% increase in the cost of Liquefied Natural Gas after Repsol decided to cancel its supply following the expropriation of YPF. Second, there is a cost related with indemnities paid by the government if expropriations occur, as well as legal costs inherent to international arbitrations. Third, and finally, governments may also bear reputational costs. On the one hand, expropriating leaders may face political costs, like audience costs in democracies (Jensen, 2008). On the other hand, there is empirical evidence that expropriation risk reduces private investment. Gastanaga et al. (1998) report a negative relationship between inflows of FDI and nationalization risk, and Allee and Peinhardt (2011) show that both present and past disputes in the International Centre for Settlement of Investment Disputes (ICSID) reduce the level of FDI directed to non-OECD countries. This means that reneging on contracts and expropriating, among other actions, does create a *stigma* for these countries.

In that spirit, the second chapter of this thesis aims to answer questions regarding the theoretical drivers and costs of expropriation risk, by constructing a Real Options model of sequential investment, and analyzing the interactions between the entry and exit options of a firm, and the government's option to expropriate. This is studied in an economy with two economic sectors: essential and non-essential. Non-essential activities are those that, although creating value, are not necessary for the normal functioning of the economy. This special characteristic will be reflected in the decisions made by the government regarding expropriation. As far as we know, the problem of how the government's decision to expropriate is affected by different "social incentives" has not yet been analyzed.

The results of our model aid to the more realistic strand of the literature[1] where firms react to expropriation by partially withdrawing investment, or underinvesting (Raff, 1992; Thomas and Worrall, 1994). In the real options model we construct, this problem of underinvestment is observed because the firm invests too early and abandons too soon compared with the case where there is no expropriation risk. To the best of our knowledge, there has been no reference in the literature to the possibility that firms have a smaller scope for losses (reflected in the abandonment decision) when the government creates a threat to expropriate its assets.

We also add to the literature on the costs of expropriation by endogenizing the costs the government bears for creating the risk of expropriation. Several authors consider that the government faces a reputation cost in terms of investment. Such costs are usually assumed to be exogenous (Schnitzer, 2002; Clark, 2003; Schwartz and Trolle, 2010). In our model, not only do we consider exogenous reputation costs, but also go further by proposing a loss/gain function for the government that allows analyzing the interaction between reputation costs and indemnity payments. This loss function accounts for the reaction of firms operating in the market and firms willing to enter, which incorporate the risk of being expropriated when one firm is threatened. We can do this thanks to the interaction among the indemnity payment, the probability of expropriation and the probability of shutting down the business. Thus, our loss function makes the compensation offered upon expropriation contingent on reputation costs. In this context, the government can derive the optimal policy in terms of indemnity payments to maximize its own gain from expropriation. We can also determine the optimal policy in terms of welfare, although this is more of a normative result, since we assume the government to be opportunistic.

The results of our model show that when the business is essential for the functioning of the economy, there is a greater welfare gain with a private, more efficient firm operating the project than when the business is not essential. Therefore, creating a threat to expropriate is also more costly in terms of welfare for essential businesses. This is in line with the results we obtain by endogenizing the reputation and indemnity costs: for essential businesses, the government's optimal policy to maximize its gain is generally to expropriate the firm instead of confiscating it: it is bound to offer a rather fair compensation, especially if the market is large. However, when the business is not essential, the government generally maximizes its gain by confiscating the firm or paying a low compensation, whatever the size of the market.

The development of the second chapter (Restrepo et al. (2015)) serves as a base for the third chapter of this thesis, which aims at determining the benefits of offering fiscal incentives to attract private investment when there is expropriation risk in the business environment. This matter of

[1] Another strand assumes that the firm withdraws all investment from the host country, usually making it return to autarky (e.g., Cole and English (1991); Schnitzer (2002); Guriev et al. (2011); Stroebel and van Benthem (2010))

analysis is motivated by the well established fact that firms are interested in foreign investment to seize economic advantages, but that these advantages can be affected by local conditions, like political factors (Jensen, 2003). In that sense, it should not be surprising to see governments offering generous incentives to compensate for the lack of appropriate conditions for investment –either political or economic (Li, 2006). For instance, Raff and Srinivasan (1998) find that tax incentives are especially likely to be observed in countries with high country risk, and Janeba (2002) argues that low credibility may lead countries to offer upfront subsidies because they are not attractive sites to investors. Yet, firms are usually aware that these special conditions are tricky, and that they will be subject to –at least creeping– expropriation (Engel and Fischer, 2010). If this is so, our setting serves as the perfect way to model the relationship between a firm and an expropriating government offering incentives to attract investment.

Although the effect of fiscal incentives on private investment has been widely analyzed (Agliardi, 2001; Agliardi and Agliardi, 2008; Panteghini, 2004; Pennings, 2000; Sarkar, 2012), little has been done on governments using fiscal incentives as a compensation for weaknesses in the business environment. Jensen and Johnston (2011), as far as we know, are the only authors addressing this issue, by studying a problem in which the leader offers tax breaks to a multinational corporation that may be expropriated later on. Thus, based on this problem and using the Real Options model in Restrepo et al. (2015), we study the effect of several fiscal incentives on both the government's decision to expropriate the business and the firm's investment decisions.

In this setting, we answer questions regarding the real benefits of using fiscal incentives to attract investment if an expropriation may occur later on. We find that if expropriation risk cannot be taken out of the picture, fiscal incentives make the economy worse off by increasing the risk of expropriation, as in Jensen and Johnston (2011). Therefore, in such a case, offering an incentive that does not exacerbate expropriation risk is the best alternative. When we go on to determine whether it is more costly for the government to offer fiscal incentives and then engage in political risk, than playing safe without offering incentives, we find that when there are neither fiscal incentives nor expropriation risk, the economy as a whole is better off, but the government is considerably worse.

Finally, after studying the theoretical effects of expropriations on the firms' value, the fourth chapter of this thesis uses an empirical methodology to determine the impact of the expropriation of subsidiaries on parent firms' value. Although news on expropriation-related events are likely to generate a market reaction with respect to the stock prices of both parent and subsidiary companies, there is a lack of empirical evidence on this subject in extant literature; perhaps Shcherbakova (2010) is the only one providing some preliminary evidence of the effect of nationalizations, although with some shortcomings. This fourth chapter aims to fill this gap.

Specifically, we investigate the short-term impact of events related to government expropriation of private property on the stock prices of the publicly listed parent company by the means of a unique database of 116 events in 12 countries from 2005 to 2013. The analysis of these events allows for separating them into two broad categories: warnings and forced divestments. What we call pre-expropriation warnings relate to references to expropriation or nationalization publicly made by the government, but do not imply the definite loss of property or control rights over the production unit. Thereupon, warnings may be followed by several government actions. These are what we call forced divestments. Our basic hypothesis is that expropriation-related events are bad news for future performance of parent companies and therefore their market value will decrease when these events are known, except in the case where assets are sold to –instead of seized by– the government.

Using this data, we measure the effect of expropriation-related events on parent firms' stock prices through an event study, a popular methodology to assess the impact of certain events on stockholders' wealth in the light of a given unanticipated event (see Brown and Warner (1980)). The results we obtain support our basic hypotheses in almost all cases, finding significant negative effects associated with several kinds of warnings. However, when we analyze forced divestments, outright expropriations do not generate any significant market response, while forced sales seem to cause positive abnormal returns.

Chapter 2

Expropriation Risk, Investment Decisions and Economic Sectors

2.1 Introduction

The wave of nationalizations in Africa and Latin America in the last decade has brought the fear of expropriation back into the picture. An expropriation can be defined as government seizure of the ownership or control rights of a firm. The problem it poses to investors is that compensation for expropriation in most cases is either nonexistent or below the fair value of the firm. Governments, in turn, find it appealing that expropriations come with the immediate benefits they obtain from seizing the assets of the firm once investment costs have been sunk.

We use Real Options and build a version of a classical sequential investment timing model in the spirit of McDonald and Siegel (1986) to investigate the investment decisions of a firm and a government in the presence of expropriation risk. The firm decides when to undertake a new investment project and has the option to shut it down if it is no longer profitable. The government must decide when to expropriate the project once it is in operation. With this model, we answer three main questions about governments' drivers for expropriations, firms' reactions to this phenomenon and the costs expropriation implies in terms of economic welfare.

The first question is related to the drivers of governments to expropriate. The existing literature approaches this question from several perspectives. For instance, governments can be considered social welfare or national income maximizers (Eaton and Gersovitz, 1984; Cole and English, 1991; Raff, 1992), risk averse agents looking for insurance (Rigobon, 2010; Stroebel and van Benthem, 2010), agents responding to political pressures to expropriate foreign firms (Engel and Fischer, 2010; Jensen and Johnston, 2011), or even as punishing multinational firms that renege on contracts (Guriev et al., 2011). An additional strand of the literature assumes an opportunistic government trying to maximize the value of an option to expropriate (Clark, 2003; Schwartz and Trolle, 2010). Without delving deep into the discussion about the political and legal incentives to expropriate, these authors focus on the operational and market factors that may encourage the government to expropriate. Our paper forms part of this literature. Modeling a government that expropriates the firm when cash flows are high, we study how the factors determining the value of the investment project affect the expropriation decision.

Second, we analyze how firms react to expropriation. There are two main options: (i) withdrawing all investment from the host country and possibly making it return to autarky (e.g., Cole and English (1991); Schnitzer (2002); Guriev et al. (2011); Stroebel and van Benthem (2010)) and (ii) partially withdrawing investment, or underinvesting (Raff, 1992; Thomas and Worrall, 1994). In our model, we observe a problem of underinvestment of the firm when there is a risk of expropriation. This happens because the firm invests too early and abandons too soon compared with the case where there is no risk. To the best of our knowledge, there has been no reference in the literature to the possibility that firms have a smaller scope for losses (reflected in the abandonment

decision) when the government creates a threat to expropriate its assets.

In the setting we propose, we are able to analyze how the firm's decisions interact with the probability of expropriation, and vice versa, which is especially useful to answer the third question in our model: what are the costs of expropriation for the government and the overall economy in terms of reputation? Several authors consider that the government faces a reputation cost in terms of investment. Such costs are usually assumed to be exogenous (Schnitzer, 2002; Clark, 2003; Schwartz and Trolle, 2010). In our model, in addition to considering exogenous reputation costs, we go further by proposing a loss/gain function for the government that allows analyzing the interaction between reputation costs and indemnity payments. This loss function accounts for the reaction of firms operating in the market and firms willing to enter based on the idea that when one firm is threatened with expropriation, all remaining investors will account for the risk of their assets being seized. We can do this thanks to the interaction among the indemnity payment, the probability of expropriation and the probability of shutting down the project once the expropriation risk has been included in the firm's discount. Thus, our loss function makes the compensation offered upon expropriation contingent on reputation costs. In this context, the government can derive the optimal policy in terms of indemnity payments to maximize its own gain from expropriation. We can also determine the optimal policy in terms of welfare, which is defined as the sum of value created by both the government and the firm. Note that because the government is opportunistic, welfare is not one of its objectives. Therefore, the welfare maximizer policy is only a normative result.

The three questions above are studied in an economy with two types of businesses: essential and non-essential. Non-essential activities are those that, although creating value, are not necessary for the normal functioning of the economy. This special characteristic will be reflected in the decisions made by the government regarding expropriation. As far as we know, the problem of how different "social incentives" of the government affect the decision to expropriate and the investment decisions made by the firm has not been analyzed yet. In terms of costs borne by the government, the most similar case is posed by Raff (1992), who analyzes the reaction of the government and the firm within the context of asymmetric information: the government only learns *after* expropriation whether it has expropriated the most costly firm to expropriate due to the extra managerial skills the owners of the firm withdraw from the country. However, our case does not assume asymmetric information.

The results of our model show that when the business is essential for the functioning of the economy, there is a greater welfare gain with a private, more efficient firm operating the project than when the business is not essential. Therefore, creating a threat to expropriate is also more costly in terms of welfare for essential businesses. This is in line with results we obtain by endogenizing the reputation and indemnity costs: for essential businesses, the government's optimal policy to maximize its gain is generally to expropriate the firm instead of confiscating it: it is bound to offer a rather fair compensation, especially if the market is large. However, when the business is not essential, the government generally maximizes its gain by confiscating the firm or paying a low compensation, whatever the size of the market.

In terms of welfare, however, regardless of whether the business is essential to the economy, the government should always pay the highest possible compensation to the firm. Because the offered indemnity has a negative relationship with the probability to expropriate, this implies that expropriation will always be suboptimal in relation to total value creation in the economy.

2.2 Assumptions

The economy modeled comprises a government and private firms. We distinguish between firms already operating and firms that are considering making an initial investment (entrants).

The investment opportunity is identified by the use of the subscript 0, while the values derived from operating businesses will not have subscripts.

We consider two scenarios. The first is the politically safe scenario, which we set as a benchmark and where the government does not intervene in the economy beyond setting the fiscal regime. The second scenario is politically risky: an opportunistic government intervenes directly

in the economy through expropriations. The risky environment is identified by the use of the superscript j, with $j = s, e$ representing a safe and a risky political environment, respectively.

Assumption 1. *The government is an opportunistic agent.*

Cole and English (1991) argue that governments can expropriate out of either desperation or opportunism. The opportunistic behavior, which is the most common, implies that expropriations are mere reactions of the government to high real prices of the product or service. In terms of our model, this implies that the government engages risky actions only when the cash flows of the project exceed a certain threshold, which we call the expropriation trigger. When cash flows are below the trigger, the government does not take any action and commits to its tax schedule.

Assumption 2. *Political risk follows a continuous process.*

In our model, the government observes the level of cash flows, and when it reaches a certain level, it engages in politically risky actions. This is in contrast to models such as those by Clark (1997, 2003) that define political risk as a Poisson process. This approach is suitable only those cases in which expropriation is regulatory.

Assumption 3. *The government distinguishes between essential and non-essential businesses and is committed to the operation of essential businesses.*

According to economic sector, the government makes a distinction between essential and non-essential sectors. The operation of businesses in essential sectors cannot be disrupted and must therefore be operated continuously either by a private investor or by the government. Non-essential sectors are sectors, whose businesses generate value for the economy once in operation but are not required for the normal functioning of an economy. These businesses are only engaged if it is profitable to do so: the government may follow a scheme to maximize the value of the project once it is operating and may abandon operations if the business is not profitable.

Essential sectors are those every country requires, such as health-care, food-security, infrastructure, transportation, etc. The essential nature of these businesses does not imply the existence of an altruistic government because opportunism drives governments to operate loss-making essential businesses in order to perpetuate power [1]. The economic sectors to which a business belongs to are identified by the use of the superscript i, in which $i = u, c$ representing essential and non-essential businesses, respectively.

Assumption 4. *The objective of the private firm is to maximize shareholder value.*

For the private firm operating in a safe political environment, there are no differences among any of the sectors, because it does not bear any social responsibilities and can abandon the project if it is no longer profitable.

Assumption 5. *The government commits to a tax scheme the firm must comply with.*

In the general case, the government's income comprises corporate taxes. In some cases, however, depending on the type of activity, it may also charge royalties, which are usually charged over public assets and when legislation determines a sovereign ownership of natural resources, regardless of whether they are located on privately owned land (Rigobon, 2010; Postali, 2009).

Assumption 6. *The firm has no outside opportunities.*

Assumption 7. *The government and the private firm are not financially constrained.*

Assumption 8. *There are no informational asymmetries.*

[1] In the case of democratic regimes, disruption to the essential sectors may trigger changes in the governing party in the following elections and may generate costs for the revenues of the government through: (i) costs associated with reduced investor confidence in the country and capital flight (Le and Zak, 2006; Lensink et al., 2000) and (ii) reductions in productivity if social unrest materializes in strikes and protests (Renn et al., 2011). In the case of autocratic regimes, although there are no political cycles pressing the current governing party, there is a real fear of regime change through social unrest.

Both the government and the private firm know all the relevant information and rationally anticipate each other's reaction.

Assumption 9. *The government is less cost-efficient than the private firm.*

Although it may not be the rule, the conception is that private firms are more efficient than public enterprises. Although in many cases these public enterprises are engaged in activities that are not directly comparable with those of private firms, there are certain organizational features that explain this government inefficiency. It can be the result of transferring resources to actors that provide political support to the government (Shleifer, 1998; Megginson, 2005) or even because public enterprises are not profit oriented, which may lead them to disregard productivity maximization as an objective (Stiglitz, 2000).

Assumption 10. *The project has uncertain cash flows, x, represented by a Geometric Brownian motion*

$$dx = \mu x dt + \sigma x dz \tag{2.1}$$

where μ is the instantaneous growth rate of cash flows, σ is their standard deviation, and dz is the increment of a standard Wiener process. We also assume that $\mu < r$, with r being the constant and known interest rate, allowing us to obtain finite solutions. We denote the return shortfall, $r - \mu$, by δ.

For both agents considered, namely, the government and the private investor, we determine the values of an investment opportunity ($G_0(x), V_0(x)$) and an operating business ($G(x), V(x)$). For the sake of conciseness, we briefly describe the value of a general claim A in which $A = G, V$ for the cases of government and private investors, respectively. The following Ordinary Differential Equations - ODEs - describe the value of this general claim in terms of the investment opportunity A_0 and operating business A.

$$0.5\sigma^2 x^2 A_{0xx} + \mu x A_{0x} - r A_0 = 0 \tag{2.2}$$

$$0.5\sigma^2 x^2 A_{xx} + \mu x A_x - r A + \pi = 0 \tag{2.3}$$

where $\pi = ax + b$ (Table 2.1) represents the cash flows accruing to each claim. The cash flows to any agent, π, comprise a variable component, a, associated with the behavior of the cash flows x, and a fixed component, b, that is independent of the evolution of x. Table 2.1 defines a and b. Remember that according to Assumption 5, the government has a tax scheme to which it is committed, and the firm must comply with it. This scheme consists of a corporate income tax, τ, and a royalty fee, ρ, that may be applied to its gross revenue. Therefore, when the firm operates the project, $ax + b$ is the after tax revenue in the value equation $V^j(x)$ and the fiscal revenue in the government's valuation of the project, $G^{ij}(x)$. The fixed component is related to the operating costs of the project, c_v, if it is operated by the private firm and c_g if it is operated by the government. Note that the basic difference between equations 2.2 and 2.3 is that the first is a homogeneous ODE ($\pi = 0$) because it values an option to invest, which does not generate any income.

Table 2.1: Specification of the ODE

$A(x)$	a	b
$G^i(x)$	1	$-c_g$
$V^j(x)$	$(1-\rho)(1-\tau)$	$-c_v(1-\tau)$
$G^{ij}(x)$	$(1-\rho)\tau + \rho$	$-c_v\tau$

The general solution to both ODEs are, respectively:

$$A_0^j(x) = B_1 x^{\beta_1} + B_2 x^{\beta_2}, \tag{2.4}$$

$$A^j(x) = \frac{ax}{\delta} + \frac{b}{r} + B_3 x^{\beta_1} + B_4 x^{\beta_2}, \tag{2.5}$$

with a and b as given in Table 2.1, and

$$\beta_1 = \frac{1}{2} - \frac{\mu}{\sigma^2} + \sqrt{\left(\frac{1}{2} - \frac{\mu}{\sigma^2}\right)^2 + \frac{2r}{\sigma^2}} > 1, \tag{2.6}$$

$$\beta_2 = \frac{1}{2} - \frac{\mu}{\sigma^2} - \sqrt{\left(\frac{1}{2} - \frac{\mu}{\sigma^2}\right)^2 + \frac{2r}{\sigma^2}} < 0, \tag{2.7}$$

β_1 and β_2 are the roots to the following characteristic polynomial

$$\left(0.5\beta^2\sigma^2 + \beta\left(\mu - 0.5\sigma^2\right) - r\right)x^\beta = 0 \tag{2.8}$$

B_j are constants to be determined given appropriate boundary conditions. For the investment opportunity, zero is an absorbing barrier for the process: no prospect of profit in the future makes the asset worth nothing. Thus, $V(0) = 0$. However, because $\beta_2 < 0$, as x goes to zero, the value function would go to infinity. Thus, B_2 is set equal to zero in order to prevent this from happening. In the case of operations in a safe environment[2] ($j = s$), B_3 is also equal to zero. This comes from imposing the condition below (2.9), which simply means that when the cash flows are considerably high, the project will never be abandoned.

$$\lim_{x\to\infty} = \frac{a}{\delta}x + \frac{b}{r} \tag{2.9}$$

2.3 The benchmark cases

This paper considers two benchmark cases: public and private provision in a politically safe environment. In the first benchmark, both the realization of the initial investment and the actual operations are solely the responsibility of the government; in this benchmark, there is no private participation. The second benchmark considers a private firm that realizes the investment and operates a business following a value maximization scheme, regardless of the type of business considered; the government merely regulates the economic environment in which the firm operates. The government receives taxes and may receive royalties depending on the type of business.

2.3.1 Public provision

The importance of analyzing public provision is twofold. First, it represents the dynamics of the value of the business once it is operated by the government when the private investors abandon or whenever the government decides to expropriate it. Second, it provides the benchmark to assess the value of private participation in the economy.

The following proposition summarizes the value generated to the government in the essential and non-essential business sectors.

Proposition 1. Public provision of operating businesses
The value of a business operated by a government in the essential sector is defined as $G^u(x)$ and its value is given by,

$$G^u(x) = \frac{x}{\delta} - \frac{c_g}{r}. \tag{2.10}$$

The value of a business operated by a government in the non-essential sector is defined as $G^c(x)$ and for $x > x_a$ its value is given by,

$$G^c(x) = \frac{x}{\delta} - \frac{c_g}{r} - \left(\frac{x_a}{\delta} - \frac{c_g}{r}\right)\left(\frac{x}{x_a}\right)^{\beta_2} \tag{2.11}$$

[2] As we will show later, for the case of expropriation risk, this condition is dropped

in which x_a represents the abandonment trigger and is given by,

$$x_a = \frac{\beta_2}{\beta_2 - 1}\frac{\delta c_g}{r}. \tag{2.12}$$

Note the extra term in the equation for the government value in a non-essential business. This term represents the value of the abandonment option, which does not exist if the business is essential. Because an abandonment option gives the opportunity to stop losses, it adds value to the business implying that this term is always positive. Therefore, the operating value of a non-essential business is higher than the operating value of an essential business.

Before investments are realized, the value for the government represents the value of an investment opportunity, summarized in the following proposition.

Proposition 2. Public provision before investment is realized
The value of an investment opportunity for a government in an essential business is defined as G_0^u and for $x < x_I^u$ its value is given by,

$$G_0^u(x) = \left(\frac{x_I^u}{\delta} - \frac{c_g}{r} - I_g\right)\left(\frac{x}{x_I^u}\right)^{\beta_1} \tag{2.13}$$

in which x_I^u represents the investment trigger and it is determined as,

$$x_I^u = \frac{\beta_1}{\beta_1 - 1}\left(\frac{\delta c_g}{r} + I_g\right). \tag{2.14}$$

The value of an investment opportunity for a government in a non-essential business is defined as $G_0^c(x)$ and for $x < x_I^c$ its value is given by,

$$G_0^c(x) = \left(\frac{x_I^c}{\delta} - \frac{c_g}{r} - \left(\frac{x_a}{\delta} - \frac{c_g}{r}\right)\left(\frac{x_I^c}{x_a}\right)^{\beta_2} - I_g\right)\left(\frac{x}{x_I^c}\right)^{\beta_1} \tag{2.15}$$

in which the abandonment trigger x_a is given by equation (2.12), and the investment trigger x_I^c is numerically determined from the following implicit equation,

$$(\beta_1 - 1)\frac{x_I^c}{\delta} - \left(\frac{c_g}{r} + I_g\right)\beta_1 - (\beta_1 - \beta_2)\left(\frac{x_a}{\delta} - \frac{c_g}{r}\right)\left(\frac{x_I^c}{x_a}\right)^{\beta_2} = 0. \tag{2.16}$$

Because the operating value is higher for a non-essential business than for an essential one, the investment trigger for a non-essential business is also naturally lower. Essential businesses need to be operated regardless of the cash flow level they generate, implying that they may be operated even under significant with losses. Therefore, it is important to be more prudent when investing in essential businesses, which in this case can be expressed as requiring a higher initial cash-flow level before undertaking the investment. Investment mistakes are more costly with essential businesses because they cannot be abandoned. It is important for public planners to bear in mind that they pursue *welfare* maximizing objectives because a government acting as a value maximizer could be tempted to prioritize investments in non-essential businesses and possibly neglect those that are essential to the economy.

2.3.2 Private provision in a safe political environment

This set-up allows assessing the impact and the costs of expropriation risk. We start by stating the value accruing to the private firm and to the government once the business is operating in proposition 3. We assume that the government imposes a tax scheme onto the firm that is held as long as the firm is in operation: the firm's cash inflows are subject to a corporate income tax, τ, and to royalties, ρ. Therefore, the terms $(1-\rho)$ and $(1-\tau)$ represent the proportion of after

tax cash inflows of the firm. While most firms are subject to corporate income taxes, royalties are only applied to certain types of economic activities. They can be considered a special fiscal regime that arises from the fact that these resources are typically owned by national states that lease production to private corporations, and this gives them the right to procure resource rents [3] (Postali, 2009; Rigobon, 2010). Examples of activities requiring royalty payments are typically oil, gas and mining activities.

Proposition 3. Operating values when there is private provision in a safe political environment *The value of an operating firm for a private investor regardless of the type of business is defined as $V^s(x)$ and for $x > x_a^s$ its value is given by,*

$$V^s(x) = \left(\frac{x}{\delta}(1-\rho) - \frac{c_v}{r}\right)(1-\tau) - \left(\frac{x_a^s}{\delta}(1-\rho) - \frac{c_v}{r}\right)\left(\frac{x}{x_a^s}\right)^{\beta_2}(1-\tau) \tag{2.17}$$

in which the abandonment trigger x_a^s is given by,

$$x_a^s = \frac{\beta_2}{\beta_2 - 1}\frac{\delta c_v}{r(1-\rho)}. \tag{2.18}$$

The value for the government if it is an essential business is defined as $G^{us}(x)$ and for $x > x_a^s$ its value is given by,

$$\begin{aligned} G^{us}(x) = \frac{x}{\delta}\rho + \left(\frac{x}{\delta}(1-\rho) - \frac{c_v}{r}\right)\tau \\ + \left(\frac{x_a^s}{\delta}(1-\rho)(1-\tau) + \frac{c_v\tau}{r} - \frac{c_g}{r}\right)\left(\frac{x}{x_a^s}\right)^{\beta_2}. \end{aligned} \tag{2.19}$$

The value for the government if it is a non-essential business is defined as $G^{cs}(x)$ and for $\frac{c_v}{c_g} > 1-\rho \Rightarrow x_a < x_a^s$ the value of $G^{cs}(x)$ is given by,

$$\begin{aligned} G^{cs}(x) = \frac{x}{\delta}\rho + \left(\frac{x}{\delta}(1-\rho) - \frac{c_v}{r}\right)\tau \\ + \left(\frac{x_a^s}{\delta}(1-\rho)(1-\tau) + \frac{c_v\tau}{r} - \frac{c_g}{r} - \left(\frac{x_a}{\delta} - \frac{c_g}{r}\right)\left(\frac{x_a^s}{x_a}\right)^{\beta_2}\right)\left(\frac{x}{x_a^s}\right)^{\beta_2} \end{aligned} \tag{2.20}$$

in which the abandonment trigger for the government x_a is given by equation (2.12).
For $\frac{c_v}{c_g} < 1-\rho \Rightarrow x_a > x_a^s$ the value of $G^{cs}(x)$ is given by,

$$G^{cs}(x) = \frac{x}{\delta}\rho + \left(\frac{x}{\delta}(1-\rho) - \frac{c_v}{r}\right)\tau - \left(\frac{x_a^s}{\delta}(\rho + (1-\rho)\tau) - \frac{c_v\tau}{r}\right)\left(\frac{x}{x_a^s}\right)^{\beta_2}, \tag{2.21}$$

The second terms of equations 2.17 and 2.19 to 2.21 are related to the abandonment option of the firm. In eq. 2.17, this term represents the value of the option to the firm, and it will always be non-negative because it adds value to the project. For the government equations, the second term can be interpreted as the government's valuation of the firm's abandonment option. There are some differences in this term, depending on the case. For an essential business (eq. 2.19), the term will most likely be below zero[4] because if the firm abandons, the government must continue operations, disregarding profitability. If the business is non-essential and the government's abandonment trigger is smaller than the firm's ($x_a < x_a^s$), then it will continue operating the business; the second term in eq. 2.20 accounts for the foregone fiscal revenue and for the value of its own abandonment option. Finally, if the government's abandonment trigger is above the firm's trigger, then the valuation of the abandonment option captures the expected loss of fiscal revenue from the firm's abandonment.

Before investments are realized, the value of the investment opportunity accruing to the private investor and the government is summarized in the following proposition.

[3] However, there are some cases in which the royalties belong to the private owner of the land. For instance, in the U.S., private owners are allowed to have mineral rights.

[4] It may be positive if the private firm is very inefficient compared to the government or if royalties generate a sufficiently large distortion in the abandonment decision of the firm

Proposition 4. Option values when there is private provision in a safe political environment
The value of an investment opportunity for a private firm regardless of the type of business is defined as $V_0^s(x)$ and its value is given by,

$$V_0^s(x) = \left(\left(\frac{x_I^s}{\delta}(1-\rho) - \frac{c_v}{r}\right)(1-\tau)\right)\left(\frac{x}{x_I^s}\right)^{\beta_1} - \left(\left(\frac{x_a^s}{\delta}(1-\rho) - \frac{c_v}{r}\right)\left(\frac{x_I^s}{x_a^s}\right)^{\beta_2}(1-\tau) - I_v\right)\left(\frac{x}{x_I^s}\right)^{\beta_1} \tag{2.22}$$

in which the abandonment trigger x_a^s is given by equation (2.18), and the investment trigger x_I^s is numerically determined from the following implicit equation,

$$(\beta_1 - 1)\frac{(1-\rho)(1-\tau)}{\delta}x_I^s - \beta_1\left(\frac{c_v(1-\tau)}{r} + I_v\right) - (\beta_1 - \beta_2)(1-\tau)\left(\frac{x_a^s}{\delta}(1-\rho) - \frac{c_v}{r}\right)\left(\frac{x_I^s}{x_a^s}\right)^{\beta_2} = 0 \tag{2.23}$$

The value of such an investment opportunity for the government in an essential business is defined as $G_0^{us}(x)$ and its value is given by,

$$G_0^{us}(x) = \left(\frac{x_I^s}{\delta}\rho + \left(\frac{x_I^s}{\delta}(1-\rho) - \frac{c_v}{r}\right)\tau\right)\left(\frac{x}{x_I^s}\right)^{\beta_1} + \left(\left(\frac{x_a^s}{\delta}(1-\rho)(1-\tau) + \frac{c_v\tau}{r} - \frac{c_g}{r}\right)\left(\frac{x_I^s}{x_a^s}\right)^{\beta_2}\right)\left(\frac{x}{x_I^s}\right)^{\beta_1} \tag{2.24}$$

The value of this investment opportunity for the government in a non-essential business is defined as $G_0^{cs}(x)$ and for $\frac{c_v}{c_g} > 1-\rho \Rightarrow x_a < x_a^s$ its value is given by,

$$G_0^{cs}(x) = \left(\frac{x_I^s}{\delta}\rho + \left(\frac{x_I^s}{\delta}(1-\rho) - \frac{c_v}{r}\right)\tau\right)\left(\frac{x}{x_I^s}\right)^{\beta_1} + \left(\left(\frac{x_a^s}{\delta}(1-\rho)(1-\tau) + \frac{c_v\tau}{r} - \frac{c_g}{r} - \left(\frac{x_a}{\delta} - \frac{c_g}{r}\right)\left(\frac{x_a^s}{x_a}\right)^{\beta_2}\right)\left(\frac{x_I^s}{x_a^s}\right)^{\beta_2}\right)\left(\frac{x}{x_I^s}\right)^{\beta_1} \tag{2.25}$$

in which the abandonment trigger for the government x_a is given by equation (2.12). The value of this investment opportunity for the government if the economic sector is commodities for the case $\frac{c_v}{c_g} < 1-\rho \Rightarrow x_a > x_a^s$ is

$$G_0^{cs}(x) = \left(\frac{x_I^s}{\delta}\rho + \left(\frac{x_I^s}{\delta}(1-\rho) - \frac{c_v}{r}\right)\tau\right)\left(\frac{x}{x_I^s}\right)^{\beta_1} - \left(\left(\frac{x_a^s}{\delta}(\rho + (1-\rho)\tau) - \frac{c_v\tau}{r}\right)\left(\frac{x_I^s}{x_a^s}\right)^{\beta_2}\right)\left(\frac{x}{x_I^s}\right)^{\beta_1} \tag{2.26}$$

Numerical results: base case and comparative statics

The following table presents the operating values (V^S, G^c and G^u), option values (V_0^S, G_0^c and G_0^u) and abandonment (x_a^s) and investment (x_I^s) triggers when investment is realized by a private investor in a safe political environment. For the base case parameters, we assume figures aimed at generating a typical business. The initial cash flow level (x_0) is 1, its growth rate (μ) is 1% (following Gorbenko and Strebulaev (2010)) and its volatility (σ) is 25% (following Eom et al. (2004)). The corporate tax rate is 15%, the royalties are assumed to be 0% and the private investor is assumed to be more efficient than the government in terms of operating costs ($c_v = 0.4$ vs $c_g = 0.6$) but equally efficient in terms of investment costs ($I_v = I_g = 20$). Finally, the risk free interest rate (r) is 6%.

Table 2.2 presents the results for the base case and the comparative statics. For the base case, we see that the value of the government when the firm is operating a non-essential business is larger than when the business is essential. As mentioned before, this is because the government

does not have the possibility to decide whether to continue operating a business in the essential sector once the private investor abandons. In addition, for these base case parameters, the firm's abandonment trigger is lower than the government's trigger for a non-essential business because (i) the private firm is operationally more efficient (by assumption) and (ii) the royalties are equal to zero (below the limit for $x_a^s > x_a$, as in Proposition 1).

Table 2.2: Private provision: operating and option values, abandonment and investment triggers

Parameters	x_a^s	$V^s(x)$	$G^{su}(x)$	x_a	$G^{sc}(x)$	x_I^s	$V_0^s(x)$	$G_0^{su}(x)$	$G_0^{sc}(x)$
Base case	0.1736	11.738	1.098	0.26	2.071	3.4559	3.711	1.021	1.05
$\mu = 0$	0.1973	9.092	0.221	0.296	1.604	3.6376	2.037	0.605	0.636
$\mu = 0.025$	0.1314	18.8	2.861	0.197	3.318	3.2076	9.214	2.23	2.248
$\mu = 0.05$	0.0421	79.342	13.976	0.063	14.002	2.8661	67.178	12.942	12.943
$r = 0.02$	0.0692	70.705	6.862	0.104	12.477	2.3472	58.529	10.313	11.587
$r = 0.1$	0.2149	6.185	0.721	0.322	1.091	4.6071	0.742	0.26	0.261
$r = 0.14$	0.239	4.175	0.552	0.358	0.737	5.7409	0.197	0.081	0.081
$\sigma = 0.05$	0.3061	11.333	2	0.459	2	1.9726	0.435	0.272	0.272
$\sigma = 0.45$	0.1021	12.769	-0.653	0.153	2.253	5.7128	6.948	1.436	1.566
$\sigma = 0.65$	0.0642	13.711	-2.109	0.096	2.42	8.7868	9.4	1.721	1.924
$\rho = 0.12$	0.1973	9.759	3.003	0.26	4.041	3.9271	2.961	1.656	1.677
$\rho = 0.24$	0.2284	7.799	4.864	0.26	5.956	4.5472	2.285	2.132	2.146
$\rho = 0.36$	0.2712	5.871	6.655	0.26	7.765	5.3998	1.687	2.44	2.449
$\tau = 0.05$	0.1736	13.119	-0.283	0.26	0.69	3.1682	4.432	0.334	0.37
$\tau = 0.3$	0.1736	9.667	3.169	0.26	4.143	4.0404	2.713	1.872	1.89
$\tau = 0.4$	0.1736	8.286	4.55	0.26	5.524	4.5915	2.109	2.296	2.308
$c_v = 0.2$	0.0868	14.262	1.937	0.26	2.517	3.0888	4.05	1.173	1.196
$c_v = 0.6$	0.2604	9.444	0.556	0.26	1.667	3.8147	3.434	0.913	0.937
$c_v = 1$	0.434	5.574	0.451	0.26	1.561	4.5144	3.007	0.769	0.777
$c_g = 0.2$	0.1736	11.738	2.092	0.087	2.204	3.4559	3.711	1.05	1.05
$c_g = 0.4$	0.1736	11.738	1.595	0.174	2.071	3.4559	3.711	1.036	1.05
$c_g = 1$	0.1736	11.738	0.104	0.434	2.071	3.4559	3.711	0.992	1.05
$I_v = 15$	0.1736	11.738	1.098	0.26	2.071	2.7719	4.39	1.159	1.212
$I_v = 25$	0.1736	11.738	1.098	0.26	2.071	4.1377	3.234	0.913	0.93
$I_v = 30$	0.1736	11.738	1.098	0.26	2.071	4.8183	2.879	0.826	0.837

Notes: This table presents the operating values (V^s, G^{su} and G^{sc}), option values (V_0^s, G_0^{su} and G_0^{sc}) and abandonment (x_a^s) and investment (x_I^s) triggers. The base-case parameter values are as follows: the initial cash flow level x_0 is 1, the growth rate of cash flows (μ) is 1%, the volatility of cash flows (σ) is 25%, the operating costs for the private firm (c_v) are 0.4, the operating costs for the government (c_g) are 0.6, the risk free rate (r) is 6% and the investment cost (I_v) is 20.

As can be observed in table 2.2, increases in the growth rate of the cash flows (μ) and decreases in the risk free rate (r) and in the operating costs of the private investor (c_v) are all associated with increases in the value of the operating business and in the value of the investment opportunity for both the government and the private investor. An increase in volatility (σ) increases the value of the operating business for the private investor and for the government if the business is non-essential. If the business sector is essential, the government only partially benefits from potential increases in x through tax collection, but it bears the negative effects of decreases in x because it is forced to operate the business following the abandonment of the private investor. The value of the investment opportunity is increasing in σ for all agents.

Changes in royalties (ρ) and taxes (τ) modify the distribution of value between the government and the private investor, in which increases in τ or in ρ increase the value accruing for the government and reduce the value accruing for the private investor, regardless of the type of business and regardless of whether the business is already operating or is still an investment opportunity. However, the results show a *Laffer curve* for royalties: the value of the government increases only up to a certain point when we vary ρ, meaning there is a point at which governments start losing revenue as a result of rising royalty rates. We do not observe a Laffer curve for corporate income tax because of the neutrality of abandonment to taxes.

In terms of the decisions to invest and to abandon, we observe that whenever a change in a parameter value translates into an increase in the operating value of the business, abandonment

occurs later (decrease in x_a) and investment occurs earlier (decrease in x_I). The exception comes with higher volatility (σ), which, by increasing the value of both options, delays the exercise of investment and abandonment. The other exception is related the neutral nature of the tax system regarding the abandonment decision: because the corporate income tax is assumed to be symmetrical, an increase in τ is associated with a decrease in the operating value for the private investor, without translating into an earlier abandonment (x_a does not change with changes in τ).

We have analyzed how changes in the base case parameters affect the decisions of the private investor and the government in terms of investment and abandonment and how it affects the value of these individual claims. Now, we consider additional measures that allow us to understand how private participation affects other aspects, such as investment timing, investment volumes, costs for the government of allowing private participation and the welfare impact of private participation.

2.3.3 Investment, public and welfare effects of private provision

Investment timing: In terms of investment timing, we analyze how changes affect the expected time in which the investment is realized. We define the expected time to investment as θ, and we know (Pennings, 2000) that the expected time to investment can be determined as

$$\theta = \frac{ln(x_0) - ln(x_I)}{\mu - 0.5\sigma^2}. \tag{2.27}$$

Because we are concerned about the changes in the investment timing induced by private provision, we express our measure of timing as follows

$$\Theta^s = \frac{\theta^v - \theta^g}{\theta^g} = \frac{ln(x_I^g) - ln(x_I^s)}{ln(x_0) - ln(x_I^g)}. \tag{2.28}$$

If $\Theta^s < 0$, private provision accelerates the realization of investments relative to public provision, otherwise investments are delayed.

Change in project's value This measures allows for determining whether the private operation of the project implies a better result in terms of project value.

$$H^s = V^s(x_0)/G(x_0) - 1. \tag{2.29}$$

Cost for the government: The cost for the government regarding an individual firm represents the difference between having private and public provisions. We define this cost as Γ for an operating business, and it is expressed as, Γ for an operating business and it is expressed as,

$$\Gamma^s = G^s(x_0) - G(x_0), \tag{2.30}$$

the cost for an individual investment opportunity is defined as Γ_0:

$$\Gamma_0^s = G_0^s(x_0) - G_0(x_0). \tag{2.31}$$

In most cases, there is an obvious opportunity cost for the government by 'allowing' private firms to operate profitable businesses because the government forgoes all the earnings the business generates in exchange for reduced tax revenues and/or royalties. However, the cost for the government should not be the most important driver of public decisions because different aspects justify the importance of private investors, such as:

- Increasing the overall level of investments because the government may redeploy its resources to other activities;
- Allowing governments to focus on their core activities, which do not imply generating profits;

- Imposing less distortions on the economy by having the government compete with private enterprises (double role of the government);
- Reducing the governmental budgets or budget deficits.

Social Welfare: We define social welfare as the overall value created by a business. We consider this an aspect that should be high on the public agenda to support the decision making process. Our measure of social welfare for an individual operating business is given by

$$\Omega^s = (V^s(x) + G^s(x)) - G(x) \tag{2.32}$$

and the social welfare for an investment opportunity is

$$\Omega_{s0} = (V_0^s(x) + G_0^s(x)) - G_0(x) \tag{2.33}$$

Altruistic governments that have the objective of maximizing welfare would focus on Ω. In turn, an opportunistic government would focus on Γ.

Numerical results

Table 2.3 presents the effects of private provision in terms of investment timing (Θ^s), investment volume (H^s), governmental costs and social welfare. The base case parameter values are the same s used in section 2.3.1. The results show that the overall benefits of private provision in terms of timing (decrease in Θ^s), investment volumes (increase in H^s) and welfare (increases in Ω^s and in Ω_0^s) are largely associated with relative private efficiency and with a reduction in the distortions introduced by taxes and royalties.

The existence of a more efficient private investor ($c_v < c_g$ or $I_v < I_g$) leads to accelerated investments, higher investment volumes and increased welfare, and in most cases it also reduces the government opportunity costs (Γ^s and Γ_0^s). The relative importance of private efficiency is also clear when we compare the effects of increases in the growth rate of the cash flows (μ) with the decreases in interest rates (r). In both cases, and regardless of the nature of the investment, businesses are more valuable (operating and in still in the project), investments are accelerated, investors are willing to commit to higher investments and welfare is increased. However, with increases in μ, the benefits of having more efficient private investors are diluted because only the present value of the cash-in-flows is increased, and the value of higher operational efficiency is reduced. With decreases in r, both the cash-in and cash-out flows are affected by the changes in r, and the differences in operating efficiency remain important. This explains why the benefits of private provision in terms of welfare (increase in Ω^s and in Ω_0^s) are significant when r decreases and why the same benefits are merely modest when μ increases. The same logic also explains the higher benefits of private provision in terms of investment timing (Θ^s) and investment volumes (H^s) for low r compared with high μ. This leads us to conclude that whenever private investors are more efficient than a government, it is more important for a government to stimulate private investment in a context of low interest rates than in a context of fast growth.

The existence of corporate taxes and royalties distorts the behavior of private investors in terms of investments and abandonment decisions (royalties only in this case). For operating businesses, there is tax neutrality because the tax system is symmetrical and the government participates in the gains and losses of the firm proportionally. Royalties are collected whether the firm presents gains or losses, and therefore, abandonment is not neutral to royalties (see expression 2.18). Although a more efficient firm ($c_v/c_g < 1$) is expected to abandon later than a government, royalties may change this, as reflected in eq. 2.20. With high royalties, following private abandonment $x < x_a^s$, the government operates the business while $x > x_a$ because the private abandonment was inefficient due to the high royalties ($c_v/c_g < 1 - \rho$). Unfortunately, as Rigobon (2010) notes, politicians tend to favor royalties over taxes, although the distortions introduced by royalties are well known in the existing literature. Bergstrom (1984)[p.177] argues that royalties change the production plans of firms. For the case of mining activities, "a system of royalties (...) is inefficient because it will induce mining companies to discontinue operations on mines before it is economically appropriate to do so and will inhibit the development of marginally efficient

mines". It is not surprising that a reduction in τ or in ρ is associated with accelerated investments (lower Θ^s), higher investment volumes (higher H^s) and increased welfare (higher Ω^s and Ω_0^s in the case of royalties and higher Ω_0^s in the case of taxes). However, because taxes and royalties represent the government's income, reductions in τ and ρ are associated with important increases in the governmental opportunity costs (decreases in Γ^s and Γ_0^s).

Overall, the benefits of private provision are more significant in the case of essential businesses. The difference in welfare is calculated as $\Delta\Omega_0^s = \Omega_0^{su} - \Omega_0^{sc}$ for investment opportunities and $\Delta\Omega^s = \Omega^{su} - \Omega^{sc}$ for operating businesses. In terms of investment opportunities (Ω_0^s), the benefits for essential businesses tend to outweigh those of non-essential businesses, apart from the following cases: high I_g, low I_v, high c_g, low τ and low r. In all these cases, private provision accelerates investments significantly relative to public provision, thus increasing the probability that the government may have to operate the business following the abandonment of private investors.

For operating businesses, the economy also experiences a higher welfare gain with the participation of private investors in essential sectors. This can be explained by the fact that in these businesses the government does not have the possibility to abandon even when running important losses. In general, a reduction in the value of the abandonment option for the government mitigates the difference in welfare gains between the different sectors (higher μ and lower r and σ). However, there are some exceptional cases in which the value of private investors generates the same social welfare value in both sectors. This happens when $x_a < x_a^s$, that is, when $c_v/c_g > 1 - \rho$. Therefore, the difference in welfare also depends on the relative efficiency of the private investors with respect to the government and on how distorting royalties are for the abandonment decision. In the case of taxes, the difference in welfare is constant because they are symmetric and do not have any effect on either of the abandonment options.

Table 2.3: Investment timing, investment volume, governmental costs and social welfare

Parameters	Essential Businesses						Non-Essential Businesses						Welfare difference	
	Θ^s	H^s	Γ^s	Γ^s_0	Ω^s	Ω^s_0	Θ^s	H^s	Γ^s	Γ^s_0	Ω^s	Ω^s_0	$\Delta\Omega^s$	$\Delta\Omega^s_0$
Base case	$-0,01\%$	$17,38\%$	-8.902	-3.353	$2,836$	$0,358$	$1,29\%$	$5,65\%$	-9.039	-3.357	$2,699$	$0,354$	$0,137$	$0,005$
$\mu = 0$	$-0,26\%$	$36,38\%$	-6.445	-1.792	$2,646$	$0,245$	$1,52\%$	$10,66\%$	-6.612	-1.796	$2,48$	$0,241$	$0,166$	$0,005$
$\mu = 0,025$	$0,31\%$	$1,23\%$	-15.71	-8.636	$3,09$	$0,578$	$0,97\%$	$-1,62\%$	-15.792	-8.64	$3,008$	$0,574$	$0,082$	$0,004$
$\mu = 0,05$	$0,61\%$	$-11,84\%$	-76.024	-66.152	$3,319$	$1,026$	$0,65\%$	$-11,87\%$	-76.03	-66.152	$3,312$	$1,026$	$0,007$	0
$r = 0,02$	$-19,59\%$	$1,01\%$	-63.138	-55.918	$7,567$	$2,612$	$-10,44\%$	$-6,86\%$	-63.439	-55.669	$7,266$	$2,86$	$0,3$	$-0,249$
$r = 0,1$	$3,81\%$	$21,01\%$	-4.39	-0.672	$1,795$	$0,069$	$4,05\%$	$11,17\%$	-4.472	-0.673	$1,713$	$0,069$	$0,082$	$0,001$
$r = 0,14$	$4,97\%$	$22,57\%$	-2.855	-0.181	$1,321$	$0,016$	$5,02\%$	$14,5\%$	-2.91	-0.181	$1,265$	$0,015$	$0,055$	0
$\sigma = 0,05$	$0,97\%$	$13,33\%$	-8	-0.251	$3,333$	$0,184$	$0,97\%$	$13,33\%$	-8	-0.251	$3,333$	$0,184$	0	0
$\sigma = 0,45$	$-1,61\%$	$27,69\%$	-10.653	-6.683	$2,116$	$0,265$	$2,16\%$	-2%	-10.777	-6.69	$1,992$	$0,259$	$0,124$	$0,006$
$\sigma = 0,65$	$-2,77\%$	$37,11\%$	-12.109	-9.232	$1,602$	$0,168$	$2,66\%$	$-6,23\%$	-12.201	-9.235	$1,509$	$0,165$	$0,092$	$0,003$
$\rho = 0,12$	$10,3\%$	$-2,41\%$	-6.997	-2.718	$2,762$	$0,242$	$11,73\%$	$-12,17\%$	-7.069	-2.73	$2,689$	$0,23$	$0,073$	$0,012$
$\rho = 0,24$	$22,12\%$	$-22,01\%$	-5.136	-2.242	$2,663$	$0,043$	$23,71\%$	$-29,8\%$	-5.154	-2.261	$2,645$	$0,024$	$0,019$	$0,018$
$\rho = 0,36$	$35,97\%$	$-41,29\%$	-3.345	-1.934	$2,526$	$-0,247$	$37,74\%$	$-47,16\%$	-3.345	-1.958	$2,526$	$-0,271$	0	$0,024$
$\tau = 0,05$	$-7,02\%$	$31,19\%$	-10.283	-4.04	$2,836$	$0,392$	$-5,81\%$	$18,08\%$	-10.42	-4.036	$2,699$	$0,395$	$0,137$	$-0,003$
$\tau = 0,3$	$12,59\%$	$-3,33\%$	-6.831	-2.502	$2,836$	$0,21$	$14,05\%$	$-12,99\%$	-6.967	-2.517	$2,699$	$0,195$	$0,137$	$0,015$
$\tau = 0,4$	$22,9\%$	$-17,14\%$	-5.45	-2.078	$2,836$	$0,03$	$24,5\%$	$-25,42\%$	-5.586	-2.099	$2,699$	$0,01$	$0,137$	$0,02$
$c_v = 0,2$	$-9,07\%$	$42,62\%$	-8.063	-3.201	$6,199$	$0,849$	$-7,88\%$	$28,37\%$	-8.594	-3.211	$5,668$	$0,839$	$0,53$	$0,01$
$c_v = 0,6$	$7,96\%$	$-5,56\%$	-9.444	-3.461	0	$-0,027$	$9,36\%$	-15%	-9.444	-3.469	0	$-0,035$	0	$0,009$
$c_v = 1$	$21,53\%$	$-44,26\%$	-9.549	-3.604	$-3,976$	$-0,598$	$23,12\%$	$-49,83\%$	-9.549	-3.622	$-3,976$	$-0,616$	0	$0,018$
$c_g = 0,2$	$25,4\%$	$-29,57\%$	-14.575	-4.253	$-2,836$	$-0,542$	$25,74\%$	$-30,04\%$	-14.575	-4.257	$-2,836$	$-0,546$	0	$0,003$
$c_g = 0,4$	$10,48\%$	$-11,96\%$	-11.738	-3.752	0	$-0,041$	$11,34\%$	-15%	-11.738	-3.757	0	$-0,046$	0	$0,006$
$c_g = 1$	$-13,94\%$	$252,15\%$	-3.23	-2.758	$8,509$	$0,953$	$-12,03\%$	$79,01\%$	-4.486	-2.756	$7,252$	$0,955$	$1,256$	$-0,002$
$I_v = 15$	$-17,79\%$	$17,38\%$	-8.902	-3.215	$2,836$	$1,174$	$-16,72\%$	$5,65\%$	-9.039	-3.195	$2,699$	$1,194$	$0,137$	$-0,02$
$I_v = 25$	$14,51\%$	$17,38\%$	-8.902	-3.461	$2,836$	$-0,227$	16%	$5,65\%$	-9.039	-3.477	$2,699$	$-0,243$	$0,137$	$0,016$
$I_v = 30$	$26,79\%$	$17,38\%$	-8.902	-3.548	$2,836$	$-0,669$	$28,44\%$	$5,65\%$	-9.039	-3.57	$2,699$	$-0,691$	$0,137$	$0,022$
$I_g = 15$	$17,22\%$	$17,38\%$	-8.902	-4.009	$2,836$	$-0,298$	$19,9\%$	$5,65\%$	-9.039	-4.037	$2,699$	$-0,326$	$0,137$	$0,028$
$I_g = 25$	$-11,06\%$	$17,38\%$	-8.902	-2.865	$2,836$	$0,846$	$-10,33\%$	$5,65\%$	-9.039	-2.858	$2,699$	$0,853$	$0,137$	$-0,007$
$I_g = 30$	$-18,84\%$	$17,38\%$	-8.902	-2.487	$2,836$	$1,224$	$-18,38\%$	$5,65\%$	-9.039	-2.473	$2,699$	$1,238$	$0,137$	$-0,014$

Notes: This table presents the cost measures for an operating project: investment timing, (Θ^s), change in firm's value (H^s), government's opportunity cost, (Γ^s), and overall value change (Ω^s). It also presents the welfare difference between the two sectors ($\Delta\Omega^s$). The subscript 0 indicates that the cost measure is calculated for an investment option. The base-case parameter values are as follows: the initial cash flow level x_0 is 1, the growth rate of cash flows (μ) is 1%, the volatility of cash flows (σ) is 25%, the operating costs for the private firm (c_v) are 0.4, the operating costs for the government (c_g) are 0.6, the risk free rate (r) is 6% and the investment costs (I_v) is 20.

2.4 Expropriation Risk

The model. Both the investor and the government have all the information keys ex-ante. The only uncertainty in this model comes from the cash-flows. Therefore, the level of cash flows that triggers the realization of investment for the private firm, x_I^e, is set knowing all of the following:

- The firm will be expropriated once the cash-flows reach x_e, the expropriation trigger of the government.
- If expropriation occurs, the government will pay an indemnity k_v to the firm and will continue operating the project, facing higher operating costs, c_g, and a reputational cost, k_r, which is the consequence of a lower aggregate level of investment. Thus, the government claim turns into that of Proposition 1 minus the costs associated with expropriation risk (k_v, k_r).
- $k_v \in [0, V^s(x)]$. The two natural boundaries for the compensation are zero (confiscation) and the fair value of the project, $V^s(x)$.
- There is an abandonment trigger for the firm, x_a^e, which also depends on the probability of expropriation. As before, abandonment does not imply any cost for the private firm.
- Upon abandonment of the firm, the project will be operated by the government if (i) it belongs to the utilities sector or (ii) if it is a commodity, and $x_a^e > x_a$.

An interesting feature of this model is the interaction between the abandonment trigger of the private firm and the expropriation trigger of the government: upon operations, because there is perfect information, the firm will anticipate whether the government is going to expropriate earlier (x_e low), and this will cause it to lean towards early abandonment (x_a^e high). The triggers mentioned in this case (i.e., x_e, x_a^e, x_I^e) do not have an analytic solution, and they must be obtained by numerically solving a system of non-linear equations (see Appendix).

Proposition 5. Operating value of private provision with expropriation risk. *The operating value of a private firm exposed to expropriation risk by the government is*

$$V^e(x) = \left(\frac{x}{\theta}(1-\rho) - \frac{c_v}{r}\right)(1-\tau) + E_1 x^{\beta_1} + E_2 x^{\beta_2} \tag{2.34}$$

where E_1 and E_2 are constants given by the conditions on firm value at the moments of abandonment and expropriation. E_1 is determined by the value of the private firm at expropriation, $V^e(x_e) = k_v$, while E_2 arises from the value of the firm at abandonment, $V^e(x_a^e) = 0$. The abandonment trigger, denoted by x_a^e, corresponds to the numerical solution of equation 2.35, which comes from the smooth pasting condition that requires that $\frac{\partial V^e(x)}{\partial x}\big|_{x=x_a^e} = 0$.

$$\frac{(1-\rho)(1-\tau)}{\delta} + \beta_1 E_1 x_a^{e\beta_1 - 1} + \beta_2 E_2 x_a^{e\beta_2 - 1} = 0 \tag{2.35}$$

The value accruing to the government is given by

$$G^{ie}(x) = \frac{x}{\theta}\rho + \left(\frac{x}{\theta}(1-\rho) - \frac{c_v}{r}\right)\tau + E_3^i x^{\beta_1} + E_4^i x^{\beta_2} \tag{2.36}$$

in which the parameters E_3 and E_4 are again determined using the value matching conditions for the government. The condition for E_3 specifies the value of the government at the moment of expropriation: $G^{ie}(x_e) = G^i(x_e) - k_v - k_r$. The condition for E_4 is that, at the moment of abandonment of the private firm, $G^{ie}(x_a^e) = G^i(x_a^e)$. The expropriation trigger, x_e, is numerically determined by solving the following implicit equation

$$\frac{(1-\rho)\tau + \rho}{\delta} + \beta_1 E_3^i x_e^{\beta_1 - 1} + \beta_2 E_4^i x_e^{\beta_2 - 1} - \left.\frac{\partial G^i(x)}{\partial x}\right|_{x=x_e} = 0 \tag{2.37}$$

This equation is the result of the smooth pasting condition $\frac{\partial G^{ie}(x)}{\partial x}\big|_{x=x_e} = \frac{\partial G^i(x)}{\partial x}\big|_{x=x_e}$, which simply states that not only the value but also the derivative of the government's functions match at the moment of expropriation.

The constants in the value equations of the firm can be interpreted as follows. E_1 captures the private firm's expected loss from the option to expropriate held by the government. Thus, it should be below zero. Moreover, because $\beta_1 > 1$, as the cash flows, x, increase, the expropriation option will have a larger impact on the value of the project (the term $E_1 x^{\beta_1}$ in eq. 2.34), on the other hand, E_2 captures the value of the abandonment option to the firm. As such, E_2 will be positive. Because $\beta_2 < 0$, as the cash flows increase, the value of the abandonment option will be close to zero, and vice versa.

The constants for the government's equations have an analogous interpretation. E_3 represents the expected profit of the government from expropriating the project. Therefore, E_3^i will be positive for both sectors. In addition, the term $E_3^i x^{\beta_1}$ will be increasing in cash flows (because $\beta_1 > 1$), so the higher the level of cash flows, the larger the impact of the option to expropriate in the government's value. In turn, the constant E_4^i can be interpreted as the valuation the government makes of the firm's abandonment option. Because the government has a specific condition upon the private firms' abandonment for each sector, the values for essential and non-essential businesses will be different. If the business is essential, the constant will be negative ($E_4^u < 0$) because the government is forced to operate the business following the abandonment of the private firm, but if the business is non-essential, then the constant will be positive ($E_4^c > 0$) because of the abandonment option embedded in the government's value. Again, because $\beta_2 < 0$, the term $E_4^i x^{\beta_2} \; \forall \, i = u, c$ will be decreasing as cash flows increase, so the value of the abandonment option is less important for high revenue states.

Proposition 6. Project value of private provision with expropriation risk
The claim for the private firm on the investment opportunity is given by:

$$V_0^e(x) = \begin{cases} \left[\frac{x}{\delta}(1-\rho) - \frac{c_v}{r}\right][1-\tau] + E_1 x^{\beta_1} + E_2 x^{\beta_2} - I_v & \text{if } x \geq x_I^e \\ \\ \left[\left[\frac{x_I^e}{\delta}(1-\rho) - \frac{c_v}{r}\right][1-\tau] + E_1 x_I^{e\beta_1} + E_2 x_I^{e\beta_2} - I_v\right]\left[\frac{x}{x_I^e}\right]^{\beta_1} & \text{if } x < x_I^e \end{cases} \tag{2.38}$$

And the investment trigger, x_I^e comes from the implicit equation:

$$(\beta_1 - 1)\frac{(1-\rho)(1-\tau)}{\delta} x_I^e - \beta_1\left(\frac{c_v \tau}{r} + I\right) + (\beta_1 - \beta_2) E_2 x_I^{e\beta_2} = 0 \tag{2.39}$$

The claim for the government when the government is threatening with expropriate:

$$G_0^{ie}(x) = \begin{cases} \frac{x}{\theta}\rho + \left(\frac{x}{\theta}(1-\rho) - \frac{c_v}{r}\right)\tau + E_3^i x^{\beta_1} + E_4^i x^{\beta_2} & \text{if } x_I^e \leq x \\ \\ \left[\frac{x_I^e}{\delta}\rho + \left(\frac{x_I^e}{\delta}(1-\rho) - \frac{c_v}{r}\right)\tau + E_3^i x_I^{e\beta_1} + E_4^i x_I^{e\beta_2}\right]\left[\frac{x}{x_I^e}\right]^{\beta_1} & \text{if } x < x_I^e \end{cases} \tag{2.40}$$

In the model, we include three types of costs of expropriation. The first cost relates to the relative inefficiency of the government compared with the private firm and is implicit in the model. This relative inefficiency is due to two factors. On the one hand, there is a direct loss from the project being run by a government, which is usually less efficient than private firms (Raff, 1992; Stroebel and van Benthem, 2010; Schwartz and Trolle, 2010; Guriev et al., 2011). On the other hand, retaliation following expropriations can increase the operating costs of the firm (e.g., Raff (1992)). For instance, financial markets may be closed for the country limiting its funding, or even when still providing funds, these usually come at a higher cost (Tomz and Wright, 2010). The same effect is also experienced in the market for raw materials and finished goods. Take the case of Argentina and the expropriation of Repsol YPF. Following the expropriation, Repsol refused to sell more liquefied natural gas to the government of Argentina, and the government experienced an increase in the costs of approximately 26% on purchases of liquefied natural gas from other suppliers.

The second cost is the reputational cost for the government, which we denote by k_r. It is usually considered as a reduction in private investment that occurs following expropriations. Empirical evidence of this reduction in private investments is presented in Gastanaga et al. (1998), who

report a negative relationship between inflows of FDI and nationalization risk in the 49 Least Developed Countries (LDCs), and in Allee and Peinhardt (2011), who, although not focused purely on expropriation, show that both present and past disputes in the International Centre for Settlement of Investment Disputes (ICSID) reduce the level of FDI directed to non-OECD countries. This means that reneging on contracts and expropriating, among other actions, do create a 'stigma' for these countries. At the theoretical level, this cost is accounted for in Schwartz and Trolle (2010) as an exogenous quantity that reduces the value for the government, while in Clark (2003), it is modeled as a Geometric Brownian Motion correlated with the value of the expropriated subsidiary in order to account for the wide range of variables that affect the cost of expropriation.

Finally, the third cost of expropriation is included in our model in the parameter k_v. This parameter reflects any costs associated with indemnities paid by the government at the moment of expropriation and has been previously included in the works of Guriev et al. (2011), Engel and Fischer (2010) and Schwartz and Trolle (2010). It is, together with taxes and royalties, one of the control or decision variables of the government. While taxes and royalties have a direct impact on the government's cash-flows and, thus, on the level of political risk, k_v is the key variable in making decisions on political risk. This variable is inversely related to the probability of expropriation: the larger the indemnity paid to the private firm, the lower the probability of expropriation (x_e will be high). That is, if $k_v \to \infty$, then $x_e \to \infty$ and $E_1 \to 0$, which means that for high levels of k_v, the results under expropriation will converge to the safe case of Proposition 3 (e.g., $x_I^e \to x_I^s$, $x_a^e \to x_a^s$, $V^e(x) \to V^s(x)$). If, instead, $k_v \to 0 \Rightarrow x_e \to 0$, the private firm would never enter because this implies immediate expropriation.

2.4.1 The exogenous case

At this point, we consider all three costs to be exogenous. While the inefficiency cost can be easily defined as exogenous because it depends on variables that are beyond government control, for instance, due to employees' weak incentives (see Shleifer (1998)), the reputation and the indemnity costs can be closely related: a government that pays a fair compensation to the firm after expropriation may have to bear a smaller reduction in investment afterwards. However, there is at least some exogenous component in them. On the one hand, there may be legal costs inherent to arbitration procedures associated with the indemnity payment. On the other hand, political leaders in democracies may face audience costs, which are generated through the domestic political process: "[e]ven if expropriations are politically popular, voters have the incentive to replace political leaders with tarnished reputations" (Jensen, 2008, 1042). Autocrats expecting to rule for a long time may also face a similar reputation cost by not protecting the property of their subjects (see Clague et al. (1996)).

To analyze the effects of expropriation risk in the investment decisions of a firm, we set the base case parameters so that the government offers a fixed compensation in the case of expropriation that is equal to half the fair value of the project at the initial cash flow level, $k_v = 0.5 * V^s(x)$), and we assume the fixed reputation costs to be $k_r = 5$. Our results show that the firm's investment will be suboptimal when the government creates a threat of expropriation. By sub-optimality, we mean that the firm will invest earlier than in the safe case[5] ($x_I^e < x_I^s$), but it will also abandon the project earlier $\left(x_a^e > x_a^S\right)$. On first sight, this may seem a bit counter-intuitive. However, by waiting longer to invest the firm exposes itself to a greater probability that the cash-flows will draw closer to the expropriation trigger x_e, which increases the probability of being expropriated sooner. Thus, the smaller scope to bear losses comes from a higher abandonment trigger. An important consequence of this result is that because the government is obliged to undertake the essential businesses upon the private firm's abandonment, it will be more costly to create threats of expropriation of essential than of non-essential businesses.

Table 2.4 summarizes the results obtained for the case of expropriation and the dynamics of the results. One of the most interesting aspects of this model is that it allows for analyzing the interactions among x_I^e, x_a^e and x_e. The results show that increases in the growth rate accelerate the investment decision of the private firm and decelerate abandonment (lower x_a^e and x_I^e), despite

[5] Nordal (2001) obtains a similar result in that higher risk accelerates the investment decisions of the firm.

the decrease in the expropriation trigger. The exact opposite effect is observed when the interest rate increases: as explained previously, a larger discounting in costs comes along with an even larger discount of benefits, therefore delaying the decision to invest and rushing the decision to abandon. This also explains why the expropriation trigger increases with increases in the interest rates. Because the option to expropriate can be considered an American call option (Clark, 2003; Schwartz and Trolle, 2010), a higher volatility of cash flows delays both the decisions of the private firm to invest and to abandon (higher x_I^e and x_a^e) and the decision of the government to expropriate (higher x_e).

For the fiscal variables, there is an interesting feature related to the expropriation trigger: higher government take through both royalties (ρ) and taxes (τ) reduces the incentives of the government to expropriate. Raff (1992), Rigobon (2010), Stroebel and van Benthem (2010), and Schwartz and Trolle (2010) arrive at a similar conclusion. The decision to abandon, however, depends on the fiscal variable: while higher royalties increase the abandonment trigger, a higher tax rate delays the decision to abandon. This difference comes from the less distortive nature of taxes: under normal conditions, they do not affect the abandonment decision, which means the decrease in x_a^e is solely the result of a lower probability of being expropriated ($\downarrow x_e$). Efficiency of the private firm has a similar impact to that of royalties: the higher the operating costs, the faster abandonment and expropriation occur. We interpret this result as evidence that mechanisms such as transfer pricing, a form of tax avoidance, may be detrimental to the safety of private firms because they are perceived by the government as attempts by the private firm to capture excess rents and proving more reasons to government to expropriate. As Rigobon (2010) notes, there is often an incentive to seize rents from private corporations whenever the revenues they obtain are perceived as excessive.

The values of the private firm (V^e, V_0^e) and of the government (G^e, G_0^e) increase with a higher rate of return, with a lower interest rate and with a higher efficiency of the private sector (lower c_v and I_v), just like in the case without political risk. However, with the threat of expropriation, the dynamics related to the volatility of cash flows is somewhat different. The government value for non-essential businesses shows the same dynamics as before, but the value of private firms is affected negatively, and the government value for essential businesses now increases as volatility increases. This is due to the option to expropriate, which increases in value as cash flows become more volatile, as in Clark (2003) and Schwartz and Trolle (2010).

Regarding the differences between essential and non-essential businesses, the government faces different constraints, and this yields different incentives in each case. The government has a higher expropriation trigger for essential than non-essential businesses. This means that expropriation is less likely to occur in a project that is considered essential for the functioning of the economy because of the extra cost imposed by the lack of an abandonment option of the government. Note, however, that for the private firm, there are no significant differences regarding decisions of when to invest and when to abandon, and thus, the value ex-ante and ex-post is not particularly affected either. This can be explained by the fact that although the probability of expropriation is higher in the case of non-essential businesses, the difference is not large enough for the firm to require additional compensation upon expropriation.

Investment, public and welfare effects of expropriation risk

The analysis regarding timing, volume of investment, and social welfare is performed based on the measurements proposed in section 2.3.2. Therefore, we have:

Expected time to investment: shows the changes in the investment timing induced by expropriation risk

$$\Theta^e = \frac{\theta^e - \theta^s}{\theta^s} = \frac{ln(x_I^s) - ln(x_I^e)}{ln(x_0) - ln(x_I^s)}. \tag{2.41}$$

If $\Theta^e < 0$, the private firm accelerates the realization of investments in the presence of expropriation, and if $\Theta^e > 0$, investments are delayed relative to the safe case.

Change in firm's value: shows, in relative terms, the amount by which private investment is reduced once expropriation is on the table.

$$H^e = V^e(x_0)/V^s(x_0) - 1. \tag{2.42}$$

Cost for the government: The cost for the government, Γ^e, shows the difference in value between the case of expropriation and the safe case. Thus, it can also be interpreted as the value of the option to expropriate. For an operating business, it is expressed as:

$$\Gamma^e = G^e(x_0) - G^s(x_0), \tag{2.43}$$

The cost for an individual investment opportunity is:

$$\Gamma_0^e = G_0^e(x_0) - G_0^s(x_0). \tag{2.44}$$

Social Welfare: In the same fashion, we define change in social welfare as the change in total value creation in the economy.

$$\Omega^e = (V^e(x) + G^E(x)) - (V^s(x) + G^s(x)) \tag{2.45}$$

and the social welfare for an investment opportunity is given by,

$$\Omega_0^e = (V_0^e(x) + G_0^e(x)) - (V_0^s(x) + G_0^s(x)) \tag{2.46}$$

Table 2.5 contains the effects of expropriation. First, investment is always reduced compared with the safe case, as shown by the negative sign in H^e. This reduction is more apparent when the change in parameter is associated with a lower expropriation trigger: a higher growth rate and a lower interest rate, reduced costs of expropriation (low k_r and k_v), and lower revenues for the government (low ρ and τ). All these variables make expropriation more valuable for the government (Γ^e and Γ_0^e increase).

Second, expropriation risk reduces total value creation (negative values for Ω^e and Ω_0^e), except when the private firm is very inefficient at the operational level relative to the government. Investment efficiency does not have the same impact. In addition, when both agents have the same operating costs, the welfare loss in the economy is zero. This means that the reduction in the investment volume of the private firm is fully counterbalanced by the increase in the value of the government (through the value of the expropriation option).

Third, investment timing is negative in most cases, implying that in general terms, under the threat of expropriation, the firm accelerates investment as predicted earlier. As expropriation becomes less likely (high x_e with respect to x_I^e), our investment timing measure Θ^e goes to zero. The only exception is the case of increases in volatility. The impact of higher cash-flow risk affects the decision of the government to expropriate more dramatically (delaying it) than the decision of the private firm to invest (accelerating it). However, overall, more volatile cash flows increase the probability that expropriation will occur, thus generating an even higher acceleration of the decision to invest in the case of political risk.

Finally, when comparing the two sectors, we observe that the private firm has nearly the same results for both. However, in the very few occasions when there are differences in the investment volume, we can see that the greater reduction in investment happens in non-essential businesses. Associated with this is the fact that the government's expropriation option is more valuable in non-essential business, where it holds the abandonment option. In line with these results, the welfare losses generated by the threat of expropriation are also higher in the essential activities projects.

Table 2.4: Cash flows triggers and values of options and operating project

	x_a^e	x_e	$V^e(x)$	$G^{ue}(x)$	x_I^e	$V_0^e(x)$	$G_0^{ue}(x)$	x_a^e	x_e	$V^e(x)$	$G^{ce}(x)$	x_I^e	$V_0^e(x)$	$G_0^{ce}(x)$
Base case	0.2026	2.6139	5.7346	5.5372	3.453	-2.3419	5.5833	0.2026	2.609	5.7298	6.5903	3.453	-2.3468	5.6178
$\mu = 0$	0.2191	2.5353	4.9911	2.9816	3.6351	-2.1031	3.4628	0.2192	2.5261	4.9822	4.4369	3.6351	-2.1121	3.5017
$\mu = 0.025$	0.173	2.8989	7.5057	12.3744	3.2046	-2.1364	11.8874	0.173	2.8982	7.5051	12.9017	3.2046	-2.137	11.9088
$\mu = 0.05$	0.1024	5.9928	16.6552	75.4875	2.8648	4.4641	74.5278	0.1024	5.9923	16.6551	75.5196	2.8648	4.464	74.5295
$r = 0.02$	0.1311	4.2652	17.6017	56.7275	2.2901	4.7569	61.5191	0.1311	4.258	17.5973	62.6432	2.2901	4.7524	62.92
$r = 0.1$	0.2296	2.6297	3.9196	2.1094	4.6067	-1.5333	1.6745	0.2296	2.6247	3.9161	2.5015	4.6067	-1.5368	1.6778
$r = 0.14$	0.2467	2.7895	3.1034	1.117	5.7409	-0.8776	0.6535	0.2467	2.7861	3.1018	1.3089	5.7409	-0.8792	0.6543
$\sigma = 0.05$	0.3074	1.5115	8.8641	3.0365	1.9726	-2.0344	1.3083	0.3074	1.5115	8.8641	3.0365	1.9726	-2.0344	1.3083
$\sigma = 0.45$	0.1538	4.2005	4.2105	6.5996	5.6823	-1.8116	9.0849	0.1538	4.2005	4.2105	9.63	5.6823	-1.8116	9.2215
$\sigma = 0.65$	0.1263	6.3127	3.2871	7.2669	8.6986	-1.3386	11.6632	0.1263	6.2954	3.2847	11.8877	8.6986	-1.3411	11.873
$\rho = 0.12$	0.2328	2.8115	4.7195	6.6435	3.9236	-2.1395	5.4481	0.2328	2.8104	4.7186	7.7405	3.9236	-2.1404	5.471
$\rho = 0.24$	0.273	3.0724	3.7054	7.7273	4.5428	-1.8862	5.188	0.273	3.0721	3.7053	8.8376	4.5428	-1.8864	5.2028
$\rho = 0.36$	0.329	3.4328	2.699	8.7623	5.3941	-1.5875	4.8006	0.3291	3.4244	2.6953	9.8724	5.3941	-1.5914	4.8097
$\tau = 0.05$	0.2034	2.4956	6.2785	4.8676	3.165	-2.465	5.6142	0.2034	2.4911	6.2735	5.9227	3.165	-2.4701	5.6579
$\tau = 0.3$	0.2011	2.8549	4.9133	6.5726	4.038	-2.08	5.3862	0.2012	2.8493	4.9089	7.6218	4.038	-2.0844	5.409
$\tau = 0.4$	0.1998	3.0829	4.3582	7.2899	4.5896	-1.8512	5.1378	0.1999	3.0765	4.3542	8.3358	4.5896	-1.8552	5.1541
$c_v = 0.2$	0.0942	2.8897	8.2566	6.1353	3.0883	-1.9612	5.4178	0.0943	2.855	8.2193	6.7825	3.0883	-1.9985	5.4668
$c_v = 0.6$	0.3273	2.3781	3.6369	5.3221	3.8056	-2.5442	5.808	0.3274	2.3705	3.631	6.4325	3.8056	-2.5504	5.8325
$c_v = 1$	0.6273	2.1172	0.9133	6.4139	4.4783	-2.4601	6.2275	0.6289	1.8077	0.8983	7.4509	4.4781	-2.4805	6.1282
$c_g = 0.2$	0.2078	1.8066	4.967	8.2793	3.4525	-3.1177	7.1834	0.208	1.7761	4.9449	8.3907	3.4525	-3.14	7.1854
$c_g = 0.4$	0.2054	2.1998	5.3219	6.7817	3.4527	-2.7589	6.2633	0.2054	2.1981	5.3202	7.2581	3.4527	-2.7606	6.2772
$c_g = 1$	0.1978	3.4751	6.5043	3.5137	3.4534	-1.5646	4.65	0.1981	3.4127	6.4541	5.7285	3.4534	-1.6152	4.7441
$I_v = 15$	0.2026	2.6139	5.7346	5.5372	2.7682	-1.662	5.7177	0.2026	2.609	5.7298	6.5903	2.7682	-1.6668	5.7791
$I_v = 25$	0.2026	2.6139	5.7346	5.5372	4.1353	-2.8191	5.4761	0.2026	2.609	5.7298	6.5903	4.1353	-2.8239	5.4983
$I_v = 30$	0.2026	2.6139	5.7346	5.5372	4.8163	-3.1748	5.3902	0.2026	2.609	5.7298	6.5903	4.8163	-3.1796	5.406
$k_r = 0$	0.2073	1.9004	5.042	6.7222	3.4525	-3.0419	6.7947	0.2073	1.8944	5.0369	7.7891	3.4525	-3.0471	6.8339
$k_r = 3$	0.2045	2.3315	5.4533	5.9332	3.4528	-2.6261	5.9888	0.2045	2.3262	5.448	6.9913	3.4528	-2.6315	6.0246
$k_r = 10$	0.1986	3.3107	6.3702	4.8135	3.4533	-1.6999	4.8409	0.1987	3.3064	6.3667	5.8563	3.4533	-1.7035	4.8734
$k_v = 0$	0.226	1.7664	2.8122	6.9736	3.4509	-5.2994	7.1015	0.226	1.7636	2.8042	8.0663	3.4509	-5.3075	7.1376
$k_v = 0,35V^s(x_0)$	0.2068	2.3647	5.1056	5.8744	3.4526	-2.9775	5.9363	0.2069	2.36	5.0995	6.9367	3.4526	-2.9837	5.9716
$k_v = V^s(x_0)$	0.1943	3.4316	7.1277	4.7254	3.4538	-0.9353	4.7392	0.1943	3.4269	7.1255	5.7582	3.4538	-0.9375	4.7715

Notes: This table presents the operating (V^e, G^{ce} and G^{ue}) and option values (V_0^e, G_0^{ce} and G_0^{ue}) for each of the claimants. It also presents the abandonment (x_a), expropriation, (x_e) and investment (x_I^e) triggers. The base-case parameter values are as follows: the initial cash flow level x_0 is 1, the growth rate of cash flows (μ) is 1%, the volatility of cash flows (σ) is 25%, the operating costs for the private firm (c_v) are 0.4, the operating costs for the government (c_g) are 0.6, the risk free rate (r) is 6% and the investment costs (I) are 20. The reputation cost for the government (k_r) is set equal to 5, and the indemnity payment, (k_v), is equal to $0.5V^s(x)$

Table 2.5: Opportunity costs and welfare losses from expropriation

	Essential Businesses						Non-Essential Businesses					
	Θ^e	H^e	Γ^e	Γ_0^e	Ω^e	Ω_0^e	Θ^e	H^e	Γ^e	Γ_0^e	Ω^e	Ω_0^e
Base case	-0.0679%	-51.1464%	4.4393	4.5621	-1.5644	-1.4909	-0.0679%	-51.1873%	4.5188	4.5683	-1.4897	-1.4895
$\mu = 0$	-0.0528%	-45.1036%	2.7604	2.858	-1.3404	-1.2822	-0.0529%	-45.2014%	2.8325	2.8661	-1.2772	-1.2831
$\mu = 0.025$	-0.0818%	-60.076%	9.5131	9.6572	-1.7812	-1.6931	-0.0818%	-60.0792%	9.5841	9.6607	-1.7108	-1.6903
$\mu = 0.05$	-0.0436%	-79.0085%	61.511	61.5863	-1.1761	-1.1278	-0.0436%	-79.0086%	61.518	61.5866	-1.1693	-1.1276
$r = 0.02$	-2.8886%	-75.1053%	49.8656	51.2066	-3.2376	-2.566	-2.889%	-75.1116%	50.1658	51.3334	-2.9417	-2.4436
$r = 0.1$	-0.0047%	-36.6276%	1.3885	1.415	-0.8769	-0.8599	-0.0047%	-36.6844%	1.41	1.4169	-0.8589	-0.8615
$r = 0.14$	-0.0005%	-25.6748%	0.5653	0.5729	-0.5068	-0.5016	-0.0005%	-25.7113%	0.5721	0.5735	-0.5015	-0.5025
$\sigma = 0.05$	0%	-21.7875%	1.0365	1.0365	-1.4327	-1.4327	0%	-21.7875%	1.0365	1.0365	-1.4327	-1.4327
$\sigma = 0.45$	-0.3068%	-67.026%	7.2529	7.6484	-1.3058	-1.1116	-0.3068%	-67.026%	7.3766	7.6553	-1.182	-1.1047
$\sigma = 0.65$	-0.4643%	-76.0254%	9.3759	9.9418	-1.0476	-0.7969	-0.4645%	-76.0425%	9.4682	9.949	-0.9576	-0.7922
$\rho = 0.12$	-0.0659%	-51.6375%	3.6401	3.7925	-1.3991	-1.3078	-0.0659%	-51.6472%	3.6995	3.7945	-1.3405	-1.3068
$\rho = 0.24$	-0.0642%	-52.4887%	2.8628	3.0562	-1.2308	-1.1152	-0.0642%	-52.4907%	2.8817	3.0565	-1.2121	-1.115
$\rho = 0.36$	-0.0625%	-54.0288%	2.1075	2.3604	-1.0646	-0.9139	-0.0626%	-54.0924%	2.1072	2.3605	-1.0686	-0.9177
$\tau = 0.05$	-0.0898%	-52.1432%	5.1506	5.28	-1.6902	-1.6167	-0.0899%	-52.1812%	5.2322	5.2874	-1.6136	-1.6144
$\tau = 0.3$	-0.0413%	-49.1738%	3.4032	3.5146	-1.3504	-1.2779	-0.0414%	-49.219%	3.4789	3.5192	-1.279	-1.2777
$\tau = 0.4$	-0.0276%	-47.4019%	2.7395	2.8422	-1.1882	-1.1175	-0.0277%	-47.4497%	2.8119	2.8459	-1.1197	-1.1179
$c_v = 0.2$	-0.0117%	-42.1077%	4.1988	4.245	-1.8066	-1.7665	-0.0118%	-42.3689%	4.2656	4.2707	-1.777	-1.778
$c_v = 0.6$	-0.1786%	-61.4894%	4.7659	4.8948	-1.0411	-1.0837	-0.1789%	-61.5518%	4.7659	4.895	-1.0469	-1.0897
$c_v = 1$	-0.5327%	-83.6141%	5.9632	5.458	1.3027	-0.0087	-0.5363%	-83.8842%	5.8898	5.3437	1.2143	-0.1434
$c_g = 0.2$	-0.0792%	-57.6858%	6.1872	6.1333	-0.5842	-0.6954	-0.0795%	-57.8737%	6.1864	6.132	-0.607	-0.719
$c_g = 0.4$	-0.0738%	-54.6618%	5.1867	5.2276	-1.2297	-1.2423	-0.0739%	-54.6764%	5.1867	5.2277	-1.2314	-1.244
$c_g = 1$	-0.0573%	-44.5893%	3.41	3.6576	-1.824	-1.618	-0.0579%	-45.0164%	3.6571	3.6945	-1.6271	-1.6317
$I_v = 15$	-0.1314%	-51.1464%	4.4393	4.5592	-1.5644	-1.4925	-0.1316%	-51.1873%	4.5188	4.5675	-1.4897	-1.489
$I_v = 25$	-0.0406%	-51.1464%	4.4393	4.5634	-1.5644	-1.4902	-0.0406%	-51.1873%	4.5188	4.5687	-1.4897	-1.4897
$I_v = 30$	-0.0266%	-51.1464%	4.4393	4.564	-1.5644	-1.4898	-0.0267%	-51.1873%	4.5188	4.5689	-1.4897	-1.4898
$k_r = 0$	-0.078%	-57.0469%	5.6243	5.7734	-1.0721	-0.9795	-0.0781%	-57.0905%	5.7176	5.7843	-0.9838	-0.9738
$k_r = 3$	-0.0719%	-53.5427%	4.8353	4.9676	-1.4497	-1.3696	-0.072%	-53.5875%	4.9198	4.9751	-1.3704	-1.3673
$k_r = 10$	-0.0591%	-45.7314%	3.7155	3.8196	-1.6526	-1.5913	-0.0591%	-45.7617%	3.7849	3.8239	-1.5868	-1.5906
$k_v = 0$	-0.1164%	-76.0425%	5.8757	6.0803	-3.0504	-2.9302	-0.1166%	-76.1105%	5.9949	6.0881	-2.9392	-2.9304
$k_v = 0,35V^s(x_0)$	-0.0771%	-56.5045%	4.7765	4.915	-1.8562	-1.7735	-0.0772%	-56.5564%	4.8652	4.9221	-1.7736	-1.7726
$k_v = V^s(x_0)$	-0.0492%	-39.2781%	3.6275	3.7179	-0.9831	-0.9283	-0.0492%	-39.2967%	3.6868	3.722	-0.926	-0.9265

Notes: This table presents the cost measures for the operating project and the option to invest: investment timing (Θ^e), change in firm's value (H^e), government's opportunity cost (Γ^e), and overall value change (Ω^e). The subscript 0 represents the cost measure for an option to invest. The base-case parameter values are as follows: the initial cash flow level x_0 is 1, the growth rate of cash flows (μ) is 1%, the volatility of cash flows (σ) is 25%, the operating costs for the private firm (c_v) are 0.4, the operating costs for the government (c_g) are 0.6, the risk free rate (r) is 6% and the investment costs (I) are 20. The reputation cost for the government (k_r) is set equal to 5, and the indemnity payment, (k_v), is equal to $0.5V^s(x)$

2.4.2 The endogenous case for indemnity and reputational costs

In the previous case, we assumed that all the decisions in terms of indemnity and reputation costs were exogenous, in the fashion of Schwartz and Trolle (2010), Guriev et al. (2011), and Clark (2003). We now depart from the full exogenous case and analyze what the decision of the government would be in terms of indemnity. Thus, we make the compensation the government would pay in the case of expropriation contingent on reputation costs (in terms of investment). Because the probability of expropriation is closely related to the indemnity, with this function the government can determine whether making expropriation more likely (by choosing a small k_v, and thus having a lower x_e) is more costly. Remember that this government is not a benevolent one and it behaves as a wealth maximizing agent. Therefore, the decision on the indemnity is based on what the government perceives as gains from expropriating one firm. However, the real impact in the economy of the expropriating risk is broader, so we also measure the total gain/loss in the overall economy as a result of the threat to expropriate one firm. To construct these measures, we assume that:

- There are $m+1$ firms operating in the economy and l firms willing to enter.
- The government has a target firm it wants to expropriate. Therefore, the expropriation threat is directed only to such firm.
- The other firms in the market, whether operating or entrants, do not know that they are not a target. Therefore, they behave as if they were a possible target for expropriation, even if the government disregards them as possible targets.

In terms of decision making, then, when determining k_v, the government maximizes its gain from expropriation. This means that it calculates a global value function G_g in which it accounts for the net gain from expropriation as well as the possible gain/loss from creating the threat to operating and entrant firms. Such function varies in k_v so that the government can determine the optimal value of the indemnity.

$$G_g = G^e(x) - G^s(x) + m\left(G^s(x_a^e, x) - G^s(x)\right) + l\left(G_0^s(x_a^e, x_I^e, x) - G_0^s(x)\right) \tag{2.47}$$

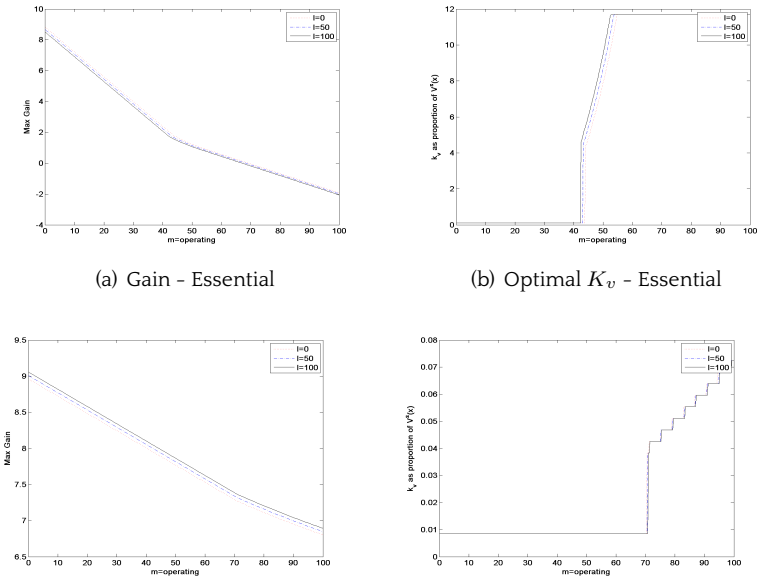
In terms of welfare, the effects of expropriation are

$$\begin{aligned} W_g = &\left(G^e(x) + V^e(x) - \left(G^s(x) + V^s(x)\right)\right) \\ &+m\left(G^s(x_a^e, x) + V^s(x_a^e, x) - \left(G^s(x) + V^s(x)\right)\right) \\ &+l\left(G_0^s(x_a^e, x_I^e, x) + V_0^s(x_a^e, x_I^e, x) - \left(G_0^s(x) + V_0^s(x)\right)\right) \end{aligned} \tag{2.48}$$

The idea here is that upon expropriation of one firm, the remaining firms react by reducing their scope to bear losses. In a certain way, this can be explained by a smaller amount of investment on the firm. Thus, it can be related to the result of Cole and English (1991), in whose setting atomistic investors must decide every period on the additional investment they will place in the host country. Given certain conditions, a possible equilibrium yields an intermediate level of investment and a moderate probability of expropriation, so that investment is not completely swept off. For entrants, the reputational consequences for the government come at the cost of the firm investing and abandoning at an earlier stage. Thus, the present value for the government associated with potential entrants is smaller whenever it creates a threat of expropriation.

Figure 2.1 shows the maximum possible gain, as described in equation 2.47, for the government in both sectors (panels (a), and (c)) and the compensation offered to the firm, as a proportion of the fair value, associated with it (panels (b), and (d)). Note that the gain the government obtains from expropriating one firm is decreasing in the number of firms operating. In the case of essential businesses, when the market is large (m is large), the optimal policy is to offer the highest possible compensation to the firm ($V^s(x)$). This is explained by the fact that operating firms account for the risk by increasing their abandonment trigger, so the probability that the businesses are abandoned increases as well. This is costly for the government because it is less efficient than the private investors, and it has no option but to take on the businesses once they are abandoned. Thus, the larger is m, the smaller is the governmental gain.

Figure 2.1: Maximum gain and optimal compensation



(a) Gain - Essential

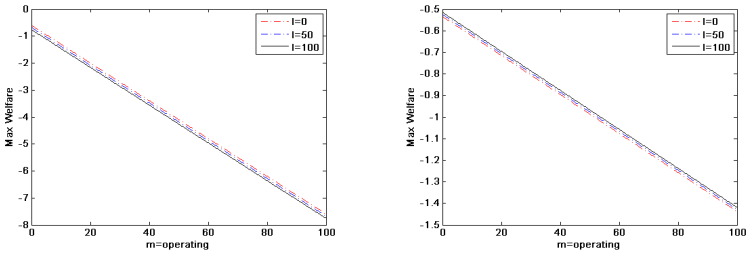
(b) Optimal K_v - Essential

(c) Gain - Non Essential

(d) Optimal K_v - Non Essential

In contrast, for non-essential activities, the government's optimal policy to maximize its gain is to confiscate the firm when the market is small and to offer a low compensation (below 10% of the fair value) when the market is large. The difference between both sectors comes from the abandonment option the government holds in the case of non-essential businesses. Because the government does not have to operate loss making non-essential businesses, its losses in this case are simply represented by uncollected taxes. Moreover, given that they abandon sub optimally early, the government may still operate these businesses because $x_a < x_a^e$ at the confiscation policy ($k_v = 0$). Additionally, note that the gain is increasing in the number of firms willing to enter because the earlier investment translates into earlier tax revenues for the government.

Figure 2.2: Maximum welfare



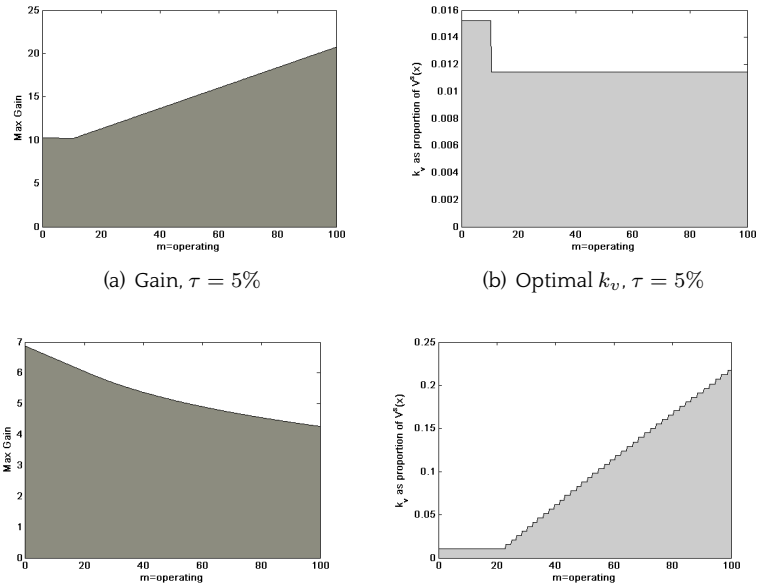
(a) Essential

(b) Non Essential

Figure 2.2 presents the maximum welfare gain the government can achieve in the presence of expropriation risk, that is, the maximum value of the function W_g (equation 2.48). Note that regardless of whether the business is essential for the economy (panel (a)) or not (panel (b)), there is always a loss that increases with market size. Thus, in terms of welfare, the government should always offer the highest possible compensation to the target firm to minimize welfare losses. This is consistent with the results for the benchmark case without expropriation risk and in the exogenous case: because the government does not have the option to abandon essential businesses makes it more valuable to have a more efficient agent operating these businesses.

The other key variables the government controls are taxes and royalties, which, by increasing governmental revenues, have a direct impact on the expropriation trigger and, therefore, on the

Figure 2.3: Low vs. High Taxes for Non-Essential Activities



(a) Gain, $\tau = 5\%$ (b) Optimal k_v, $\tau = 5\%$

(c) Gain, $\tau = 30\%$ (d) Optimal k_v, $\tau = 30\%$

level of political risk[6]. Taxes and royalties have different impacts on the optimal policy of the government because royalties distort in a more visible way the decisions of the private firm. In the case of taxes, if the business is not essential (figure 2.3), low taxes induce the government to confiscate the firm, regardless of the size of the market, and high taxes induce the government to pay a compensation below 25% of the fair value of the firm to maximize its gain. Although the gain visibly decreases from with high taxes, there are still gains from expropriating the target firm.

If the business is essential (figure 2.4), then low taxes make the government confiscate the firm for small to medium sized markets, and pay a high compensation only when the market is large enough, where, instead of maximizing a gain, the government has to minimize the loss of expropriation. A higher tax rate, in turn, makes the government offer 100% of the fair value of the firm as compensation, even for small markets, to maximize its gain from expropriation, which becomes negative in a context of medium to large markets.

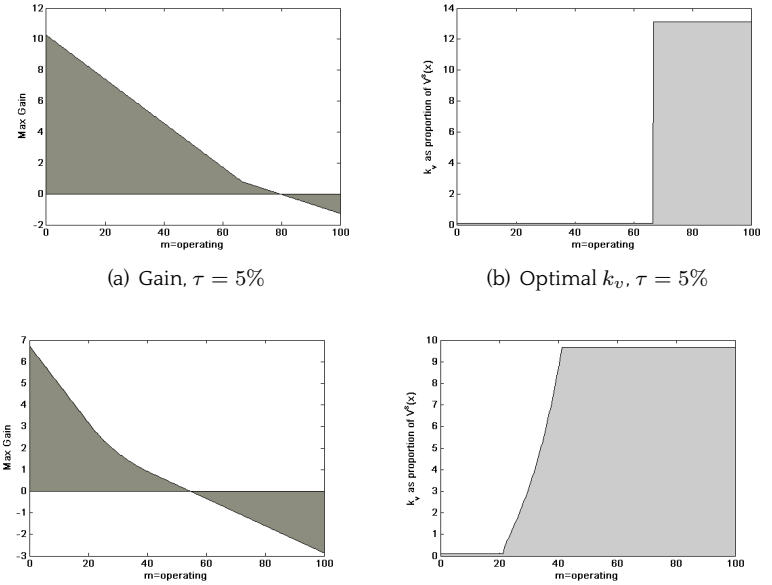
Higher taxes in the presence of political risk delay the exercise of the option to invest and of the option to abandon [7], which explains why the effect of taxes is so tangible in terms of gains and losses: the interval in which the government receives fiscal revenue is larger, and the incentive to expropriate is smaller. Therefore, when taxes are high, there is more to lose with the threat to expropriate in both sectors: in order to maximize its gain, the government must offer a high compensation to the firm even if the market is still small.

Royalties have a more dramatic impact on the optimal policy of the government regarding the indemnity paid to the target firm. A moderate to high royalty rate is the only case in which the government is induced to offer the highest possible compensation to the firm to maximize the gain from expropriation when the business is not essential. This is because the distortion it creates in terms of incentives of the private firm is more noticeable, in line with the idea that this distortion leads the firm to abandon operations sub optimally (Bergstrom, 1984). This is also more visible in terms of welfare: even paying the highest possible compensation to the firm, as the market grows larger there is dramatic increase of the loss the overall economy experiences.

[6] We omit l from this analysis because it has a negligible effect, as seen from previous figures.

[7] The latter is merely an interaction between the expropriation trigger and the abandonment trigger because abandonment under normal conditions is neutral to taxes.

Figure 2.4: Low vs. High Taxes for Essential Activities



(a) Gain, $\tau = 5\%$

(b) Optimal k_v, $\tau = 5\%$

(c) Gain, $\tau = 30\%$

(d) Optimal k_v, $\tau = 30\%$

2.5 Final remarks

This paper uses a real options model to analyze the irreversible decisions that must be made by a firm and by a government regarding investment in a new project. The firm must decide when to undertake the project and when to shut it down, knowing that the government may not credibly commit to not expropriating once investment costs have been sunk. We consider that the project may be operating in one of two sectors in the economy, one of which is essential for the government. This means the government will have to keep essential businesses in operation once the private investors abandon. If the project is not essential, the government only operates the business following abandonment of the private investor if it is profitable.

This paper answers questions regarding three main issues. First, we analyze what drives the government to expropriate. We find that the decision to expropriate is delayed when the relative efficiency of the private firm and the government's fiscal income (high royalties and taxes) increases because the value of the option to expropriate is worth less. In turn, when the cash flow growth rate and volatility are high, the government is more prone to expropriate. Although increases in volatility imply a larger value for the government, we observe that if the business is in the essential sector, the value of the option to expropriate is lower and increases less than in the case of a non-essential business due to the existence of the possibility to abandon in the latter.

Second, is the question of how firms react to expropriation? In general, operating in a politically risky environment accelerates both investment and abandonment. If expropriation occurs later in expectation, the firm delays investing and abandoning operations because of the reduced risk. However, the interaction between the expropriation decision and the abandonment decision is important to answer this question. There are two cases worth noting. On the one hand, when cash flow growth is high, even though there is a larger risk of expropriation (lower x_e), the firm waits longer to abandon because the larger cash flows compensate for the expropriation risk bearing. On the other hand, the fiscal variables have a different impact on the abandonment decision. Taxes generate a reduction in the abandonment trigger: a higher tax rate lowers the risk of expropriation (increases x_e), and consequently, the firm waits longer to abandon. We know that the reduction in x_a^e is the direct consequence of the firm being exposed to less risk because the abandonment decision in a safe environment is neutral to taxes. Royalties, in turn, distort the abandonment decision of the firm so that the firm abandons earlier with higher royalties

despite the smaller expropriation risk it has to bear. The implication is that in the presence of expropriation risk, the firm will be better off paying more taxes, as long as doing so does not have a direct impact on the abandonment decision.

Finally, we analyze the costs of expropriation. Instead of assuming only exogenous reputation or indemnity costs, our construction allows us to study the interaction between both. We can calculate the costs or benefits faced by an opportunistic government when it threatens one firm with expropriation and determine the loss in terms of welfare that this expropriation threat can cause. The results of our model show that when the business is essential for the functioning of the economy, there is a greater welfare gain with a private, more efficient firm operating the project than in the case where the business is not essential. Therefore, creating a threat to expropriate is also more costly in terms of welfare for essential businesses.

The previous results are in line with results we obtain by endogenizing the reputation costs of expropriation. For essential activities, the government's optimal policy to maximize its gain is generally to expropriate the firm instead of confiscating it; it is bound to offer a rather fair compensation, especially if the market is large. However, when the business is not essential, the government generally maximizes its gain by confiscating the firm or paying a low compensation, whatever the size of the market. In terms of welfare, however, regardless of whether the business is essential to the economy, the government should always pay the highest possible compensation to the firm. Because the offered indemnity has a negative relationship with the probability to expropriate, this implies that expropriation will always be suboptimal in regard to total value creation in the economy.

2.6 Appendix

Proof of Proposition 1

Essential The government has no option to abandon this project. Therefore, the constant B_4 from equation 2.5 is equal to zero. In addition, recall that $B_3 = 0$ (from equation 2.9). Replacing these two conditions in equation 2.5 yields the value of the claim for public provision in utilities.

Non-essential The first value matching condition is given by the fact that if the cash flows are very large, the government will never abandon the project, so the present value of the project in such cases is simply the value of the operating facility (eq. 2.50). The second value matching condition (eq. 2.49) is related to the option to abandon. Having this option makes the constant B_4 positive, which means there is a level of cash flows, x_a, in which the government stops operations and abandons the project with a net salvage value of zero. The abandonment trigger, x_a is determined by the smooth pasting condition (eq. 2.51).

$$G^c(x_a) = 0 \tag{2.49}$$

$$\lim_{x\to\infty} G^c(x) = \frac{x}{\delta} - \frac{c_g}{r} \tag{2.50}$$

$$\left.\frac{\partial G^c(x)}{\partial x}\right|_{x=x_a} = 0 \tag{2.51}$$

Proof of Proposition 2 In this case, the option value is equivalent for the two sectors, $i = u, c$. To obtain a particular solution for equation 2.2, we impose three conditions. The first is that $B_2 = 0$ (from eq. 2.4): this ensures that the option value goes to zero for small values of x, where the option is very out of the money. The second is a value matching condition: it simply states that at the moment of investment, the option to invest will be worth as much as the operating project, deducting the investment cost (eq. 2.52). Finally, the smooth pasting condition states that the level of cash flows at which investment will be carried out is optimally chosen (eq. 2.53).

$$G_0^i(x_I) = G^i(x_I) - I_g \tag{2.52}$$

$$\left.\frac{\partial G_0^i(x)}{\partial x}\right|_{x=x_I} = \left.\frac{\partial G^i(x)}{\partial x}\right|_{x=x_I} \tag{2.53}$$

Proof of Proposition 3 The private firm has two value matching conditions. The first makes $B_3 = 0$ because, as long as cash flows are high enough (eq. 2.55), the private firm will continue operations. The second describes the option to abandon: the constant B_4 is positive and adds value to the claim of the private firm. Upon abandonment, at the cash flows level x_a^s, the project is worth zero (eq. 2.54). The abandonment trigger is set through the smooth pasting condition (eq. 2.56).

$$V^s(x_a^s) = 0 \tag{2.54}$$

$$\lim_{x\to\infty} V^s(x) = \frac{x}{\delta}(1-\rho)(1-\tau) - \frac{c_v}{r}(1-\tau) \tag{2.55}$$

$$\left.\frac{\partial V^s(x)}{\partial x}\right|_{x=x_a^s} = 0 \tag{2.56}$$

The government's claim is related to whether it has the abandonment option if the firm abandons the project. Therefore, we have one value matching condition for each sector.

Essential The government has to take the project, disregarding possible losses. The value matching condition 2.57 states that, upon the firm's abandonment, the claim for the government is the same as in the case of public provision.

$$G^{us}(x_a^s) = G^u(x_a^s) \tag{2.57}$$

Non-essential The government takes the project after the firm's abandonment if and only if $\frac{c_v}{c_g} > (1-\rho)$, as this implies that the private firm will abandon earlier than the government ($x_a^s > x_a$). Thus, the value matching condition will be equation 2.58. Otherwise, the government does not take the project after the firm abandons. Thus, its value when the firm abandons is equal to zero (eq. 2.59).

$$G^{cs}(x_a^s) = G^c(x_a^s) \tag{2.58}$$

$$G^{cs}(x_a^s) = 0 \tag{2.59}$$

Proof of Proposition 4 The private firm has one value matching condition (eq. 2.60), from which the value of the option at the moment of investment is equal to the value of the project when cash flows are equal to x_I^s minus the investment cost. The smooth pasting condition 2.61 allows us to find the investment trigger of the private firm.

$$V_0^s(x_I^s) = V^s(x_I^s) - I_v \tag{2.60}$$

$$\left.\frac{\partial V_0^s(x)}{\partial x}\right|_{x=x_I^s} = \left.\frac{\partial V^s(x)}{\partial x}\right|_{x=x_I^s} \tag{2.61}$$

The government has one value matching condition (eq.2.62) that shows that its claim on the private firm's investment option is equal to its claim on the operating project when cash flows are equal to the investment trigger x_I^s.

$$G_0^{is}(x_I^s) = G^{is}(x_I^s) \tag{2.62}$$

Proof of Proposition 5 In addition to the option to abandon the project (eq. 2.63), which happens at the cash flows level x_a^e, the firm has to account for the possibility of being expropriated and receiving a fixed compensation, k_v (eq. 2.64). The smooth pasting condition (eq. 2.65) indicates that the abandonment trigger is optimally chosen by the firm, accounting for the possibility of expropriation.

$$V^e(x_a^e) = 0 \tag{2.63}$$

$$V^e(x_e) = k_v \tag{2.64}$$

$$\left.\frac{\partial V^e(x)}{\partial x}\right|_{x=x_a^e} = 0 \tag{2.65}$$

The government also has two value matching conditions and one smooth pasting condition. The first condition (eq. 2.66) is related to the case of abandonment of the private firm and works the same as in the safe case: depending on the sector, $i = u, c$, the government has the option to skip the project's operation (commodities if $x_a > x_a^e$) or not (utilities). The second determines that the value of the government's claim upon expropriation is the value in the public provision case of Proposition 1 minus the costs of expropriation (eq. 2.67). Finally, the smooth pasting condition states that the expropriation trigger, x_e, is optimally chosen by the government (eq. 2.68).

$$G^{ie}(x_a^e) = G^i(x_a^e) \tag{2.66}$$

$$G^{ie}(x_e) = G^i(x_e) - k_v - k_r \tag{2.67}$$

$$\left.\frac{\partial G^{ie}(x)}{\partial x}\right|_{x=x_e} = \left.\frac{\partial G^i(x)}{\partial x}\right|_{x=x_e} \tag{2.68}$$

Proof of Proposition 6 There are two conditions imposed on equation 2.2 in order to obtain a particular solution for the option value to the private firm. The value matching condition states that when the cash flows reach the investment trigger of the firm, x_I^e, the value of the option to invest equals the value of the project, accounting for the threat of expropriation, minus the investment cost (eq. 2.69). The smooth pasting condition (eq.2.70) indicates that x_I^e is optimally chosen.

$$V_0^e(x_I^e) = V^e(x_I^e) - I_v \tag{2.69}$$

$$\left.\frac{\partial V_0^e(x)}{\partial x}\right|_{x=x_I^e} = \left.\frac{\partial V^e(x)}{\partial x}\right|_{x=x_I^e} \tag{2.70}$$

The government, for either sector, only has one value matching condition (eq.2.71) that shows that its claim on the private firm's investment option is equal to its claim on the operating project at the investment trigger x_I^e level of cash flows.

$$G_0^e(x_I^e) = G^e(x_I^e) \tag{2.71}$$

Chapter 3

Fiscal Incentives, Private Investment and Expropriation Risk: A Real Options Approach

3.1 Introduction

In general, a higher level of investment generates more fiscal revenue, both directly –from corporate taxes- and indirectly –through increased employment and expenses. What is more, if investment is in the form of FDI –Foreign Direct Investment[1]– it brings additional benefits to the country, since it is often associated with technology and know-how transfers, as well as development of local entrepreneurship; even a positive effect on Human Rights indicators can be associated with FDI (see Blanton and Blanton (2007)). Therefore, it is reasonable to expect that governments are willing to take measures leading to an increase in investment in their countries.

On the other hand, the main reason why firms are interested in realizing foreign investment is to seize Ownership, Location and Internalization advantages –the OLI paradigm. Although these characteristics are purely economical, they can be seriously affected by local conditions, like political factors. For example, Jensen (2003) argues that political risk has a direct impact on internalization advantages: when uncertainty is high, the costs of internalizing production are greatly increased. Countries that lack appropriate conditions –either political or economic, often offer generous incentives to compensate for those weaknesses[2] (Li, 2006). This explains why some governments may be interested in offering incentives to investment. In fact, Raff and Srinivasan (1998) find that tax incentives are especially likely to be observed in countries with high country risk, among other characteristics. Moreover, according to Janeba (2002), low credibility may lead countries to offer upfront subsidies because they are not attractive sites to investors. This is so even though it is generally accepted that incentives are only of secondary importance to investors, because they first examine the economy's fundamentals and then go on to analyze profitability (Rosenboim et al., 2008). Nonetheless, governments have an easier task offering incentives than addressing changes in those fundamentals (UNCTAD, 2000).

But these incentives may be tricky. According to Engel and Fischer (2010, p.2), compensation is likely to be observed when prices of the product are low: governments offer specially favorable conditions to induce firms to invest. However, investors don't take these special conditions as credible, since they realize that they will be expropriated –at least through creeping expropria-

[1] This is the type of investment realized into a company or entity located in a foreign country. Unlike portfolio flows, which are considered indirect investments, FDI has a more permanent nature.

[2] Governments may also offer incentives to encourage certain enterprises or categories of enterprises to behave in a given manner, like being greener, or supporting the growth of a given key sector. However, we only focus on cases where incentives are offered to compensate for weaknesses in the investment environment.

tion[3]. Besides, as Raff and Srinivasan (1998) point out, since one of the main reasons to attract *import-substituting FDI* is increased tax revenue, offering tax incentives to attract investment is contradictory. What really happens is that there's an informational asymmetry that leads the government to grant fiscal incentives in order to signal a positive investment environment.

In this paper we build on the idea that fiscal incentives are offered as a compensation for some kind of weakness in the business environment of a host country. Although there is extensive literature regarding the effects of fiscal incentives in a 'normal' environment (e.g. Agliardi and Agliardi (2008); Agliardi (2001), Panteghini (2004), Pennings (2000), Wong (2011, 2012), Sarkar (2012), Barbosa et al. (2016)), the study of fiscal incentives in a context of expropriation risk is incipient. Jensen and Johnston (2011, p. 672) make an exercise in which the leader offers tax breaks to a multinational corporation operating in a context where the business may be expropriated by the government. According to their model, (i) lower corporate tax rates are associated with higher levels of political risk, and (ii) the firm is more willing to invest in a context of expropriation risk when there is a tax break. We build on their idea and study the effect of several fiscal incentives on the investment decisions of a firm, and the decision of the government to expropriate the business[4].

In particular, we study a firm's decision to invest in and to liquidate a partially reversible project, and a government's decision to expropriate it. We do this through *real options analysis*, which borrows the concept of financial options to value decisions regarding real projects. This method of analysis offers some advantages over traditional capital investment appraisal techniques, because real options account for the possibility to delay investment decisions, and to include the irreversibility of real investments into the valuation process (Décamps et al., 2005; McDonald and Siegel, 1986). This is specially true if we consider that it is generally not optimal to go by the rule of undertaking the project the first time the net present value is positive, due to the value of information (Sundaresan, 2000). In this sense, real option analysis incorporates a very desirable characteristic into the valuation process: It allows the firm to value its opportunity to wait until uncertainty is resolved before it commits to certain actions that are costly to reverse (Damaraju et al., 2015).

We follow the approach in Restrepo et al. (2015) and consider a sequential investment model, in which the firm holds two options, (i) to invest in a new project and (ii) to liquidate the business if it becomes unprofitable at operations. The government holds only one option: to expropriate the operating business. Since the government wants to attract investment, and is aware that it must compensate the firm for the existence of expropriation risk, it offers one of three fiscal incentives to the firm: (i) tax breaks, (ii) lower royalties, and (iii) upfront investment subsidy. The firm has this information ex-ante, and knows that the government will expropriate the business at a certain cash-flow level. This means that we have no informational asymmetries and that the only source of risk of the model comes from the volatility of cash flows.

There are several questions that arise when we analyze fiscal incentives in a safe political environment and in a risky one. First, the firm may be better off with a given type of incentive. We find that the answer to this question depends on the riskiness of the environment, the level of cash inflows, and the stage of the business. Second, expropriation risk: with or without incentives? Although the answer to this question also depends on the stage of the business (i.e. investment or operations), we find that offering incentives in this case makes the economy worse off, but this is because the government's loss is larger than the firm's gain. In this sense, our model supports the idea in Jensen and Johnston (2011) that lower taxes are associated with larger levels of political risk, and that firms may be more willing to invest if taxes are lower. And third, we want to analyze whether it is more costly for the government to offer fiscal incentives and then engaging in political risk, than playing safe without offering incentives. We find that when there are neither fiscal incentives nor expropriation risk, the economy as a whole is better off, while the government is considerably worse.

The paper is organized as follows. Section 3.2.2 defines the incentives we study. Section 3.2

[3]Creeping expropriation is a term commonly used to refer to ways of appropriation of profits by the government, through taxes and other means, without specifically taking control of the firm.

[4]We focus on outright expropriation: the loss of property or control rights over the business. Creeping expropriation is out of the scope of this paper

presents the assumptions necessary to construct our model. Section 3.3 develops the model within a safe political scenario and a politically risky case. Section 3.4 presents a numerical example, and Section 3.5 concludes.

3.2 Assumptions

3.2.1 Generalities

This economy is comprised by two agents, the government and a private firm. The private firm wants to invest in a new project, which is its only investment opportunity, and the government collects taxes if investment is undertaken and the business is operating. This business has the characteristic of being infinitely lived, and requires that the firm pays a one time, non depreciable, investment cost, I_v, to develop it. Although the time span is infinite, the business can be liquidated by its owner if it is no longer profitable. In that case, part of the investment cost can be recovered at liquidation, and the owner can obtain a net salvage value $\lambda < I_v$. Therefore, we say that this business is partially reversible[5].

The business has uncertain cash flows, x, that we assume to be represented by a Geometric Brownian Motion (GBM):

$$dx = \mu x dt + \sigma x dz \tag{3.1}$$

where μ is the instantaneous growth rate of cash flows, σ their standard deviation, and dz is the increment of a standard Wiener process. We also assume that $\mu < r$, being r the constant and known interest rate, so that we are able to obtain finite solutions. We denote the return shortfall, $r - \mu$, by δ.

There are two stages in our analysis: investment and operations. The private firm decides when to invest in the new project, based on the operational results of such project. This means that we first need to solve for the firm and for the government value at operations to understand when the firm will undertake investment. At operations, the firm determines a cash flow level that triggers liquidation, and the government determines the cash flow level that triggers expropriation. The firm makes the decision on investment in the new project using this information. All the decisions of the firm are made to maximize shareholder value, which is the only objective of the firm.

The assumption of the cash flows following a GBM determines not only the dynamics for the firm, but also the government's behavior regarding expropriation. This allows for establishing two particular features. First, we assume that the government only expropriates in the good states of the world. In other words, our government is an opportunistic agent expropriating only when the business cash-flows are high enough[6]. And second, expropriation risk follows a continuous process. Some authors model expropriation as a Poisson distribution (e.g. Clark (1997)), but when the analysis is based on an opportunistic government, it makes sense to assume that instead of randomly expropriating, the government observes the evolution of cash flows to take action when it is more convenient in terms of business value.

We also assume that there are no informational asymmetries for neither of the agents. When the firm makes the decision on investment, it can completely predict the behavior of the government. On the one hand, it knows that there is a tax scheme that it must comply with, and that the government commits to such scheme, so that there are no surprises in terms of fiscal policy during the life of the business. This also implies that the firm knows ex-ante the type of incentive that the government will grant. On the other hand, it is well aware that there is a risk to be expropriated, and knows how the government makes the decision on expropriation.

The government is interested in the firm to invest earlier and abandon later, since this means a larger stream of fiscal revenue. Given the risk of expropriation, for the firm to accelerate its investment or delay the business's liquidation, it must be compensated in some way. In our model this compensation comes from offering better conditions in terms of fiscal variables. Therefore,

[5] If the net salvage value is zero, then the business is considered irreversible.

[6] This assumption implies ruling out expropriations that occur out of desperation, as described in Cole and English (1991).

the firm is granted one of the fiscal incentives mentioned below.

3.2.2 Fiscal Incentives

A fiscal incentive to investment can be any transfer of funds, reduction in tax payments, etcetera, that benefits a firm, industry or sector. According to González (1996), from the perspective of financial law, incentives from the government can be categorized into two groups[7]. The incentives in the first group have a direct connection between revenue and public spending. They suppose a favorable treatment in tributary terms: it is a fiscal expenditure that is realized as a "no-income". Jones and Steenblik (2010) refer to them as *revenue forgone or not collected*. These fiscal incentives are designed to reduce the tax burden of enterprises.

The other type of incentives in González (1996) is canalized directly from public spending, so that there is an outlay of public revenue, and it is therefore considered as a public expenditure. Non financial incentives belong to this group. Examples of these are dedicated infrastructure and services, provided only for the purposes of the particular business[8] (Jones and Steenblik, 2010; UNCTAD, 2000). Financial incentives, like government grants, and preferential credits, also belong to this group.

As for the type of incentives that countries offer, it seems that developed countries are prone to confer incentives related to public spending, like grants and subsidies, while developing countries prefer to encourage investment by the means of incentives that reduce fiscal income (UNCTAD, 2000). Since the government is an opportunistic agent trying to compensate for the expropriation risk present in the economy, in this paper we assume that the government offers fiscal incentives in the first category of 'no fiscal income' in order to compensate the firm. We consider three incentives:

Lower tax rate The government offers the firm to reduce its corporate tax rate, τ, by an amount $0 < \psi < \tau$. Given the set-up of the model, this reduction in the corporate tax rate is equivalent to the government offering an income *tax credit*, and to a *tax refund* or *tax rebate*. With this incentive, the firm's investment decision is affected through the results on operations.

Lower royalties rate Several economic activities, such as mining, gas and oil exploitations, and –in some countries- forestry, require that the firm exploiting natural resources pay a royalty fee, as these are considered to be sovereign property. Royalties are a special form of tax that is directly charged on gross income. In this case, the firm observes a reduction in its royalty fee, ρ, by $0 < \phi < \rho$.

Investment Tax Credit The government offers a subsidy at the moment investment, that we call investment tax credit –ITC–: This turns the investment cost of the firm into $I_v - S^s$. Within this category, we could fit an investment grant (with no contingencies from the part of the government) or tax allowance in which the firm gets to declare part of its capital expenses to reduce the fiscal burden the year the investment is made. Note that since this is a one time grant, unlike the previous cases, there will be no impact whatsoever on the operating results of the firm.

3.3 Setting up the model

This section follows closely the approach in Restrepo et al. (2015). We derive the value equations for the investment opportunity and for the operating business for all the agents. We start by defining the Ordinary Differential Equation (ODE) that describes the dynamics of a general claim, A, which can represent the value of the firm, $A = V$, or the value of the government, $A = G$. In all cases, the subscript 0 denotes the investment opportunity, while the lack of such subscript

[7] Although we make this distinction here, in our model the direct effect for the government is the same for any type of incentive: The value it obtains from the business is reduced. This is because we only analyze the government's valuation of the business.

[8] General infrastructure is not categorized as an incentive.

denotes the claim at operations. We also use the superscript $j = \psi, \phi, s$ to represent the cases we study: tax cut (ψ), reduction in royalties (ϕ), and ITC (s). The case of no incentives will be free of superscript. This notation will be maintained throughout the rest of the paper.

3.3.1 The benchmark: A safe political environment

To assess the costs of expropriation risk, we need to establish a benchmark: A safe political environment. Using this setting we can observe the effect of fiscal incentives on the firm's decisions, as well as the costs they generate for the government. Notice that having no expropriation risk implies that the only decision maker in this case is the firm, and the government only observes and collects taxes.

Value equations for an operating business

The ODE describing the dynamics of the value of an operating business is

$$0.5\sigma^2 x^2 A_{xx} + \mu x A_x - rA + \Pi = 0 \tag{3.2}$$

where $\Pi = ax - b$ represents the profit flow accruing to the firm and the government, where x represent the cash inflows of the business, and a and b are described in Table 3.1. For the firm, the term $a_v^j x - b_v^j$ is the after tax profit flow, and for the government, $a_g^j x - b_g^j$ is the fiscal income.

Table 3.1: Cash flows accruing to the government and the firm

	Firm		Government	
	a_v^j	b_v^j	a_g^j	b_g^j
No incentive	$(1-\rho)(1-\tau)$	$c_v(1-\tau)$	$\rho + (1-\rho)\tau$	$c_v\tau$
Tax cut	$(1-\rho)(1-(\tau-\psi))$	$c_v(1-(\tau-\psi))$	$\rho + (1-\rho)(\tau-\psi)$	$c_v(\tau-\psi)$
Reduction in royalties	$(1-(\rho-\phi))(1-\tau)$	$c_v(1-\tau)$	$(\rho-\phi) + (1-(\rho-\phi))\tau$	$c_v\tau$
ITC	$(1-\rho)(1-\tau)$	$c_v(1-\tau)$	$\rho + (1-\rho)\tau$	$c_v\tau$

The general solution to ODE (3.2) is given by

$$A(x) = \frac{a}{\delta}x - \frac{b}{r} + B_3 x^{\beta_1} + B_4 x^{\beta_2}, \tag{3.3}$$

with a and b as defined in Table 3.1, and

$$\beta_1 = \frac{1}{2} - \frac{\mu}{\sigma^2} + \sqrt{\left(\frac{1}{2} - \frac{\mu}{\sigma^2}\right)^2 + \frac{2r}{\sigma^2}} > 1, \tag{3.4}$$

$$\beta_2 = \frac{1}{2} - \frac{\mu}{\sigma^2} - \sqrt{\left(\frac{1}{2} - \frac{\mu}{\sigma^2}\right)^2 + \frac{2r}{\sigma^2}} < 0, \tag{3.5}$$

β_1 and β_2 are the roots to the following characteristic polynomial

$$\left(0.5\beta^2\sigma^2 + \beta\left(\mu - 0.5\sigma^2\right) - r\right)x^\beta = 0 \tag{3.6}$$

Propositions 7, and 8 present the particular solutions to the problem for each claimant in a safe political environment.

Firm value When the business is in operations, equity holders obtain their post-tax income and also value the option they hold to liquidate the business when the cash inflows reach a low enough level, $\hat{x}^j$. Proposition 7 shows the dynamics for equity value in our model, $V^j(x)$. In equation 3.7, the first term accounts for the stream of cash flows after tax. The second term is the value of the option to liquidate the business, which is obtained by noting that $V^j(\hat{x}^j) = \lambda$, where λ represents the claim of equity holders upon bankruptcy. The critical value at which the business is liquidated comes from the smooth pasting condition that $\frac{\partial V^j(x)}{\partial x}|_{x=\hat{x}^j} = 0$, which yields our result for $\hat{x}^j$ presented in equation 3.8.

Proposition 7. *Equity value for an operating business*

$$V^j(x) = \frac{a_v^j}{\delta}x - \frac{b_v^j}{r} + \left(\lambda - \left(\frac{a_v^j}{\delta}\hat{x}^j - \frac{b_v^j}{r}\right)\right)\left(\frac{x}{\hat{x}^j}\right)^{\beta_2} \tag{3.7}$$

with a_v^j and b_v^j as defined in table 3.1, and the abandonment trigger is given by:

$$\hat{x}^j = \frac{\beta_2}{\beta_2 - 1}\frac{\delta}{a_v^j}\left(\lambda + b_v^j\right) \tag{3.8}$$

Proof: *See Appendix* •

The quotient $\left(\frac{x}{\hat{x}^j}\right)^{\beta_2}$ in the abandonment option can be interpreted as the value of one Euro contingent on future bankruptcy[9]. Besides, since $\beta_2 < 0$, the value of the abandonment option at large cash flow levels will be close to zero, and the value of equity will be approximately equal to its income and expenses accruals.

Government's value Now we look at the value the government assigns to the business given the fiscal income that it generates on operations. We denote the government's valuation by $G^j(x)$, which is presented in Proposition 8. There are two main terms in equation 3.9. The first term is the fiscal income stemming from royalties and corporate income taxes. The second term represents the government's valuation of the abandonment option, because if the business is liquidated, the government's value will be $G^j(\hat{x}^j) = 0$.

Proposition 8. *Government's value of an operating business*

$$G^j(x) = \frac{a_g^j}{\delta}x - \frac{b_g^j}{r} - \left(\frac{a_g^j}{\delta}\hat{x}^j - \frac{b_g^j}{r}\right)\left(\frac{x}{\hat{x}^j}\right)^{\beta_2} \tag{3.9}$$

Proof: *See Appendix* •

Value equations for an investment opportunity

The ODE that describes the dynamics of the investment opportunity is

$$0.5\sigma^2 x^2 A_{0xx} + \mu x A_{0x} - rA_0 = 0 \tag{3.10}$$

where the terms A_{0x} and A_{0xx} are the first and second partial derivatives of the claim with respect to x. Notice that the only difference regarding ODE in eq. 3.2 is that this one reflects the fact that neither of the agents have cash flows accruing before the investment is undertaken ($\Pi = 0$), which means that the returns to this asset are given only by the expected capital gain (Dixit, 1989). The general solution to this ODE is given by

$$A_0(x) = B_1 x^{\beta_1} + B_2 x^{\beta_2}, \tag{3.11}$$

and β_1 and β_2, as defined in equations 3.4 and 3.5, are the roots to the characteristic polynomial in equation 3.6. The particular solution for each claimant is obtained by imposing certain conditions at the boundaries. Propositions 9, and 10 describe the particular solutions obtained for the private firm, and for the government, respectively.

Firm value Here we consider the firm's initial decision to invest in the project. Since the firm has no other assets, the value of the option is the same as the initial value of the firm. We follow Dixit and Pindyck (1994) to find the investment trigger of the firm. In order to do this, we need to determine the value of the investment opportunity at the moment of investment, which will be equal to the value of the operating business at the moment in which investment is undertaken, minus the investment costs. That is, $V_0(\tilde{x}^j) = V^j(\tilde{x}^j) - (I_v - S^j)$, for all j. Equation 3.12 represents the value of the investment opportunity for a firm that is fully internally financed. The investment trigger, $\tilde{x}^j$, is the numerical solution of equation 3.13. Such equation comes from the smooth pasting condition $\frac{\partial V_0^j(x)}{\partial x}|_{x=\tilde{x}^j} = \frac{\partial V^j(x)}{\partial x}|_{x=\tilde{x}^j}$.

[9] This quotient can thus be interpreted as a measure of the probability of bankruptcy (Leland, 1994)

Proposition 9. Firm's value of an investment option
Since the project is fully internally financed, the value of the investment opportunity is:

$$V_0^j(x) = \left(\frac{a_v^j}{\delta}\tilde{x}^j - \frac{b_v^j}{r} + \left(\lambda - \left(\frac{a_v^j}{\delta}\hat{x}^j - \frac{b_v^j}{r}\right)\right)\left(\frac{\tilde{x}^j}{\hat{x}^j}\right)^{\beta_2} - (I_v - S^j)\right)\left(\frac{x}{\tilde{x}^j}\right)^{\beta_1} \tag{3.12}$$

is the value of the investment option to the firm. The investment trigger, $\tilde{x}^j$ is the solution to the implicit equation:

$$(\beta_1 - 1)\frac{a_v^j}{\delta}\tilde{x}^j - \beta_1\left(\frac{b_v^j}{r} + I_v - S^j\right) + (\beta_1 - \beta_2)\left(\lambda - \left(\frac{a_v^j}{\delta}\hat{x}^j - \frac{b_v^j}{r}\right)\right)\left(\frac{\tilde{x}^j}{\hat{x}^j}\right)^{\beta_2} = 0 \tag{3.13}$$

Proof: *See Appendix* •

The first and second terms in equation 3.12 represent the after tax profit flow and the value of the abandonment option at the moment of investment, respectively. The third term represents the funds required to undertake investment: the (partially) sunk investment cost, I_v, and a subsidy, S^j (if it applies) that may be granted by the government upon investment. The quotient $\left(\frac{x}{\tilde{x}^j}\right)^{\beta_1}$ can be seen as the value of one unit of account contingent on future investment.

Government The government values this investment opportunity because if the project is undertaken, it will receive fiscal income. Equation 3.14 represents its valuation of the option, and its interpretation is analogous to the case of the firm. It comes from imposing the value matching condition that $G_0^j(\tilde{x}^j) = G^j(\tilde{x}^j) - S^j$.

Proposition 10. Government's value of an investment opportunity

$$G_0^j(x) = \left(\frac{a_g^j}{\delta}\tilde{x}^j - \frac{b_g^j}{r} - \left(\frac{a_g^j}{\delta}\hat{x}^j - \frac{b_g^j}{r}\right)\left(\frac{\tilde{x}^j}{\hat{x}^j}\right)^{\beta_2} - S^j\right)\left(\frac{x}{\tilde{x}^j}\right)^{\beta_1} \tag{3.14}$$

Proof: *See Appendix* •

3.3.2 Business environment with expropriation risk

As we mentioned before, governments that lack the appropriate conditions to attract more investment are prone to offer incentives to compensate firms. Hence, it would not be surprising to see governments that cannot rule out expropriation risk offer special incentives to firms. In our model, as in Restrepo et al. (2015), Schwartz and Trolle (2010), and Clark (1997), the government holds an American call option on the private firm: the option to expropriate. As such, the government maximizes this option's value. Expropriation will occur when the business cash flows reach a sufficiently high level, ε^j –the *expropriation trigger*. Nevertheless, the government cannot make its decision independently from the firm's decisions, since the incorporation of expropriation risk into the firm's valuation of the business affects directly its liquidation option and abandonment trigger, $\hat{x}^j$. Thus, there is an interdependency between the firm's abandonment trigger and the government's expropriation trigger, and their relationship should be negative (see Restrepo et al. (2015)). However, in our context, we have several fiscal incentives offered by the government, and each of them affects different elements of the firm's business profit flow. Their effect on the interaction of the triggers, business valuation and welfare, is the main question we try to answer with the model developed below.

Value equations for an operating business

At operations, there are two crucial decisions in this setting, and they are made in the context of no informational asymmetries: first, abandonment or liquidation of the private firm, and second, expropriation of the business by the government. Such decisions are interdependent: the firm decides on liquidation taking into account the government's decision to expropriate, and vice versa. The value equations of the firm will therefore reflect how the risk of being expropriated affects its operational results, knowing the decision rules of the government. If and when the firm is expropriated, the value of equity will be $V_e^j(\varepsilon^j) = k_v$, where $k_v \geq 0$ is an indemnity paid by the government to the firm. And if the cash flows reach the abandonment trigger, $x = \hat{x_e}^j$, equity value will be equal to its salvage value: $V_e^j(\hat{x_e}^j) = \Lambda^j$. Proposition 11 represents this dynamics.

Proposition 11. Firm's value of an operating business with expropriation risk
The operating value of equity of a firm that receives incentive j and is exposed to expropriation risk by the government is given by

$$V_e^j(x) = \left(\frac{a_v^j}{\delta}x - \frac{b_v^j}{r}\right) + C_1^j x^{\beta_1} + C_2^j x^{\beta_2} \tag{3.15}$$

where, a_v^j and b_v^j are given by Table 3.1, and C_1^j and C_2^j are constants given by the value matching conditions of the firm upon abandonment and expropriation. The abandonment trigger of the private firm, $\hat{x_e}^j$, is numerically determined by solving the following implicit equation:

$$\frac{a_v^j}{\delta} + \beta_1 C_1^j \hat{x_e}^{j\beta_1 - 1} + \beta_2 C_2^j \hat{x_e}^{j\beta_2 - 1} = 0 \tag{3.16}$$

Proof: *See appendix* •

As we have mentioned before, when the government values the business, it takes into account the firm's decision to liquidate, given the fact that if cash flows are low (i.e. there is no incentive to expropriate) and the firm abandons, it will lose its fiscal revenue. This means that the government's value upon abandonment of the private firm will be $G_e^j(\hat{x_e}^j) = 0$.

It also accounts for several other costs at the time of expropriation (i.e. $x = \varepsilon^j$): a cost in terms of efficiency, a reputational cost, k_r, and an indemnity payment to the firm, k_v, which is crucial for the decision making process of the government, since $k_v \to \infty \Rightarrow \varepsilon^j \to \infty, \hat{x_e}^j \to \hat{x}^j$ (see Restrepo et al. (2015)). Note that since firms usually get (at most) the fair value of the business, we set $V^j(x_0)$ as a natural upper bound for the indemnity payment. We also assume that after expropriation, the firm has no liabilities left with the government, so that the lower bound is $k_v = 0$.

Once expropriation takes place, the business is operated by the government. Therefore, the business's value will be given by the discounted earnings, the expropriation costs, and the value of the abandonment option. Like the firm, the government may liquidate the business if cash inflows fall to $\hat{x^g}$, its own abandonment trigger, and obtain the salvage value λ. These dynamics are presented in Proposition 12.

Proposition 12. Government's value of a business operated by a private firm, with expropriation risk

$$G_e^j(x) = \left(\frac{a_g^j}{\delta}x - \frac{b_g^j}{r}\right) + C_3^j x^{\beta_1} + C_4^j x^{\beta_2} \tag{3.17}$$

in which C_3^j and C_4^j are constants determined by the value matching conditions at expropriation and abandonment, and ε^j is the expropriation trigger, numerically determined by solving the following implicit equation:

$$\frac{a_g^j}{\delta} + \beta_1 C_3 \varepsilon^{j\beta_1 - 1} + \beta_2 C_4 \varepsilon^{j\beta_2 - 1} - \left.\frac{\partial G(x)}{\partial x}\right|_{x=\varepsilon^j} = 0 \tag{3.18}$$

Where the function $G(x)$, which will be the same for all the cases, $j = t, r, s$, represents the dynamics of the value of the business to the government after expropriation has taken place, .

$$G(x) = \frac{x}{\delta} - \frac{c_g}{r} - k_v - k_r + \left(\lambda - \frac{\hat{x^g}}{\delta} + \frac{c_g}{r}\right)\left(\frac{x}{\hat{x^g}}\right)^{\beta_2} \tag{3.19}$$

where $\hat{x^g}$ represents the abandonment trigger of the government, and it is defined as:

$$\hat{x^g} = \frac{\beta_2}{\beta_2 - 1}\delta\left(\lambda + \frac{c_g}{r}\right). \tag{3.20}$$

Proof: *See appendix* •

Value equations for an investment opportunity

As in the benchmark model, both the firm and the government value this investment opportunity based on the results on operations. In this case, they also account for the possibility that the business will be expropriated when the cash flows reach the level ε^j. Proposition 13 shows the value of the investment opportunity (eq. 3.21) and the implicit equation whose solution is the investment trigger (eq. 3.22).

Proposition 13. Firm's value of an investment opportunity with expropriation risk
The claim for the private firm is given by:

$$V_{0e}^j(x) = \left(\frac{a_v^j}{\delta}x - \frac{b_v^j}{r} + C_1^j \tilde{x_e}^{j\beta_1} + C_2^j \tilde{x_e}^{j\beta_2} - (I_v - S^j)\right)\left(\frac{x}{\tilde{x_e}^j}\right)^{\beta_1} \tag{3.21}$$

Where $\tilde{x_e}^j$ is the investment trigger that comes from the implicit equation:

$$(\beta_1 - 1)\frac{a_v^j}{\delta}\tilde{x_e}^j + \beta_1\left(\frac{d}{r} - \frac{b_v^j}{r} - (I_v - S^j))\right) + (\beta_1 - \beta_2)C_2^j \tilde{x_e}^{j\beta_2} = 0 \tag{3.22}$$

Proof: *See appendix* •

Proposition 14. Government's valuation of an investment opportunity with expropriation risk
The claim for the government on an investment opportunity when it threatens with expropriation:

$$G_{0e}^j(x) = \left(\frac{a_g^j}{\delta}\tilde{x_e}^j - \frac{b_g^j}{\delta} + C_3^j \tilde{x_e}^{j\beta_1} + C_4^j \tilde{x_e}^{j\beta_2} - S^j\right)\left(\frac{x}{\tilde{x_e}^j}\right)^{\beta_1} \tag{3.23}$$

Proof: *See appendix* •

3.3.3 Cost measures

In order to have a clearer interpretation of results, we borrow from Restrepo et al. (2015) to establish some measures that allow for a comparison of the incentives. The idea is to use a benchmark scenario that allows us to collate the results of the government, the firm and the economy in general. The measures are intended to provide information about the timing of abandonment and investment decisions, and about value changes.

The timing of decisions to invest and to disinvest In order to determine whether the firm accelerates its decision to invest in the project, we measure *investment timing* as:

$$\Theta_0^j = \frac{\ln(\tilde{x}) - \ln(\tilde{x}^j)}{\ln(x_0) - \ln(\tilde{x})} \tag{3.24}$$

where x_0 is the initial cash flow level, and $\tilde{x}$ represents the investment trigger. We also define *liquidation timing* as:

$$\Theta^j = \frac{\ln(\hat{x}) - \ln(\hat{x}^j)}{\ln(x_0) - \ln(\hat{x})} \tag{3.25}$$

If $\Theta < 0$ it means the critical decision is accelerated when incentives are offered, and if $\Theta > 0$ it means it is delayed.

Value changes The following measures allow to compare the differences in value once the fiscal incentives have been introduced. We define them in terms of operating results, but they can also be defined for the investment opportunity using the same logic. In that case, they will be identified with the subscript 0 (e.g. Γ_0^j).

Change in firm's value: This measure shows the change in firm's value when a fiscal incentive is introduced.

$$H^j = \frac{V^j(x_0)}{V(x_0)} - 1 \tag{3.26}$$

Government's opportunity cost: By offering fiscal incentives, the government is giving up fiscal income. Γ^j represents the forgone fiscal income for each type of incentive offered.

$$\Gamma^j = \frac{G^j(x_0)}{G(x_0)} - 1 \tag{3.27}$$

Overall value change: While the firm is better off with the incentives, the government is worse off. With this measure we are able to determine which of the effects weights more in the overall value creation process. In that sense, we define Ω^j as:

$$\Omega^j = \frac{\left(V^j(x_0) + G^j(x_0)\right)}{\left(V(x_0) + G(x_0)\right)} - 1 \tag{3.28}$$

3.4 Numerical Example

In this section we discuss the numerical results we obtain from both the safe case (no political risk) and the politically risky case. The parameter values for the base case are set as follows: the initial cash flow level is $x_0 = 1$, the growth rate is $\mu = 0.01$, the volatility $\sigma = 0.25$, the interest rate is $r = 0.06$, and the costs of the private firm are $c_v = 0.4$ in operations, and $I_v = 20$ to invest in the project. The recovery rate of the firm if the business is shut down is $\lambda = 0.20 I_v$. The policy variables in this case, are set at $\tau = 0.15$ and $\rho = 0.05$. In order to determine the different effects of the risk of expropriation for the three types of incentives, we establish a comparability point in which all three incentives lead the firm to invest at the same time; that is, $\tilde{x}^{\psi} = \tilde{x}^{\phi} = \tilde{x}^{s}$. We initially set the reduction in the tax rate as $\psi = 0.03$, which is around the corporate tax reductions observed in some countries during 2012, according to the World Bank Group and PwC (2014)[p.13]. Based on these figures, we then find the reduction in royalties, and the ITC that make the firm's decision to invest indifferent among any of these options.

3.4.1 Politically safe scenario: Which incentive is better and for whom?

Table 3.2 shows the results we obtain for the politically safe scenario. The investment and liquidation triggers in the table are the levels of cash flows at which the firm takes the intended action: either to invest or to liquidate. For example, the firm's investment trigger is 3.4897, which means that once the expected cash flows reach this level, the investment option will be exercised. Note that all three types of incentives yield the same investment trigger, as we set the exercise to yield this result. In order for the firm to invest at the same time as if the government offers a reduction in taxes of 3%, the government should reduce royalties in $\phi = 2.65\%$, or offer an ITC of $S^s = 3.33\% I_v = 0.6660$.

Table 3.2 also contains the value accruing to each agent in each of the stages we consider. On the one hand, $V^j(x)$ and $G^j(x)$ represent the value of the business in the phase of operations, assuming that the cash flows are currently $x_0 = 1$. Remember that this value represents the discounted flow of profits plus the value of the abandonment option of the firm. On the other hand, $V_0^j(x)$ and $G_0^j(x)$ account for the value of the project before investment is realized (since we assume that $x_0 = 1 < \tilde{x}^j$).

Table 3.2: Private provision in a safe political environment

	$\hat{x}^j$	$V^j(x)$	$G^j(x)$	$\tilde{x}^j$	$V_0^j(x)$	$G_0^j(x)$	Incentive
No incentive	0,3117	11,7885	2,7936	3,5870	3,4120	1,3397	
	Incentives						
Tax cut	0,3073	12,1651	2,4223	3,4897	3,6070	1,1685	0,0300
Lower royalty	0,3033	12,2003	2,3912	3,4897	3,5818	1,1938	0,0265
ITC	0,3117	11,7885	2,7936	3,4897	3,4834	1,2920	0,0333

In order to interpret these results more easily, we resort to the cost measures defined in Section 3.3.3 to see what happens in a politically safe scenario once fiscal incentives are offered to the firm. Table 3.3 presents the results. First, related with the setting of the exercise, note that

$\Theta_0^j = -2,153\%$, for $i = \phi, \psi, s$. This means that the firm accelerates its investment decision compared to the case of no incentives. In contrast, Θ^j does vary for incentives that affect results on operations: $\Theta^j > 0$ for $i = \phi, \psi$, which means that the firm waits longer to abandon the business. This is especially true in the case of a reduction in the royalty rate, $\Theta^\phi = 2,359\%$, since they have a more distortive effect on abandonment decisions than taxes.

Table 3.3: Loss-gain measures for each incentive type

	Operations				**Investment option**			
	H^j	Γ^j	Ω^j	Θ^j	H_0^j	Γ_0^j	Ω_0^j	Θ_0^j
Tax cut	3,1946%	-13,292%	0,0361%	1,2188%	5,7173%	-12,7792%	0,5023%	-2,153%
Lower royalty	3,4937%	-14,4037%	0,065%	2,3592%	4,9785%	-10,8888%	0,5048%	-2,153%
ITC	0%	0%	0%	0%	2,0938%	-3,5621%	0,4992%	-2,153%

If the incentive benefits the firms at operations, the conclusion on which incentive is better depends on the stage of the project. According to the results in table 3.2, at operations, the government's opportunity cost, Γ, the change in firm's value, H, and the overall value change, Ω, are higher when the incentive is a reduction in royalties. But when we observe the value of the investment opportunity, the tax cut is the incentive that improves the most the results of the firm and the economy (H_0^ψ and Ω_0^ψ are the largest), and worsens the most the government's situation (Γ_0^ψ is the smallest). This result is associated with the following phenomenon:

- For low levels of cash flows, the firm is better off with the reduction in royalties, because the fiscal savings caused by costs are dominant (a higher tax rate implies a larger term $-c_v\tau/r$)
- When cash flows are high enough, then the firm is better off (and the government worse off) with the reduction in taxes, because the benefits of the fiscal savings are smaller if cash flows are high.

This result has an implication in terms of the expected behavior of an opportunistic government that does not fully commit to a tax regime. For a given level of cash flows the government might switch from one tax system to the other. Particularly, the government may try to encourage investment through a reduction in royalties for high levels of cash flows, and switch to offer a tax cut for a low level of cash flows.

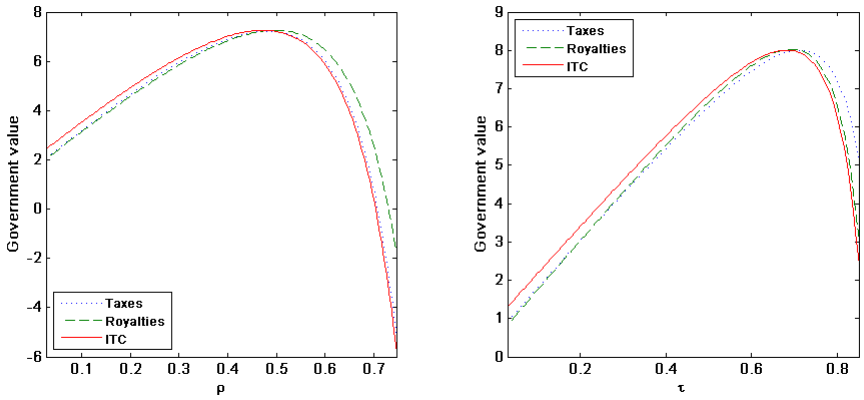
As for the government, notice that although it has a positive value in all cases (in table 3.2, $G(x)$, $G_0(x) > 0$), all the measurements of its opportunity cost (Γ^j, Γ_0^j) are negative. This is because the incentives imply a reduction in the fiscal income. In spite of this, the overall value change (Ω^j and Ω_0^j) is positive in all the cases, implying that the increase in firm's value with the incentives is more significant than the cost born by the government. Therefore, in this context, fiscal incentives are beneficial for the economy.

Related with this, we can analyze the dynamics of the government's value equations when we vary the main fiscal variables in our model (τ and ρ). In particular, we observe a *Laffer curve* with both of them. A Laffer curve shows the variation of fiscal revenue with respect to taxes. Particularly, it refers to the fact that there are two tax rates, one lower than the other, that will yield the same fiscal revenue. The idea behind a Laffer curve is that changes in taxes have two effects on government's revenue: The arithmetic effect implies that a decrease in taxes reduces fiscal revenue by that amount, and the economic effect recognizes the positive impact that lower tax rates have on the economy, by the means of work, output, etc. (Laffer, 2004). In our model the economic effect of taxes is observed through the impact of tax and royalty rates on the abandonment decision of the firm. Since the government's value of the business lies totally on the tax collections it can obtain, the value equations, G_t, G_r, and G_s can be considered as the value of fiscal revenue.

Figure 3.1 presents the evolution of the value equations of the government when we change the corporate income tax rate (left panel), and when we change the royalty fee (right panel). The government's value equations are left skewed, which implies that once the maximum royalty fee or tax rate is surpassed, the government's fiscal income decreases very fast. Note that the Laffer curve in royalties differs from the Laffer curve in corporate income taxes: the government

has a bigger scope to increase corporate income taxes before it reaches its maximum value (e.g. for G_t, $\rho_{\max} = 0.48$, while $\tau_{\max} = 0.71$). This result is not surprising, if we consider that royalties, by taxing gross revenue, are a more distortive fiscal regime than corporate taxes[10].

Figure 3.1: Government value functions



3.4.2 Expropriation risk and political incentives

We continue to use the parameter values set in the previous section as base case scenario, including the values of fiscal incentives found to make the firm's investment decision in the safe case indifferent to any of them ($\psi = 3\%$, $\phi = 2.65\%$, $S^s = 3.33\% I_v = 0.6660$). And we make two additional assumptions: (i) the reputation cost is set to $k_r = 5$, and (ii) the indemnity offered by the government is a fixed amount $k_v = 0.5V(x_0)$. This means that the government commits to pay half the fair value of a business that doesn't receive any fiscal incentives, at the initial cash flow level x_0. The triggers and value functions results are presented in Table 3.4.

Table 3.4: Triggers and Value functions: Expropriation risk

	$\hat{x_e}^j$	ε^j	V_e^j	G_e^j	$\tilde{x_e}^j$	V_{0e}^j	G_{0e}^j
No incentives	0,4135	2,6101	6,3677	6,5486	3,5692	-2,3008	5,599
	Incentives						
Tax cut	0,4088	2,5436	6,4442	6,4306	3,4717	-2,4095	5,664
Lower royalty	0,4022	2,5409	6,4874	6,41	3,4724	-2,4137	5,665
ITC	0,4135	2,6101	6,3677	6,5486	3,4714	-2,2287	5,550

In order to interpret these results more easily, we use the costs measures defined in Section 3.3.3, taking two benchmarks. First, we compare our results with the case where there is expropriation risk, but no incentives are offered. Comparing these results with the case where the government compensates for the risk of expropriation by offering incentives gives an idea of whether these are actually beneficial for an economy with such institutional weakness. Second, we use as benchmark the politically safe scenario with no fiscal incentives, to determine if investment if the incentives are enough to attract the same level of investment.

Expropriation *with* or *without* incentives?

The results are presented in Table 3.5. We start by analyzing the operating business, whose results only change if $\phi, \psi > 0$. In general terms, we would expect that a smaller expropriation trigger (more risk) generates a higher abandonment trigger (less scope to bear losses), since this is how the firm reacts to political risk in our model. This would be the case for a reduction in royalties ($\varepsilon^\phi < \varepsilon^\psi, \varepsilon^s$). However, the private firm is better off when the incentive is a reduction in

[10] This is why royalties may induce abandonment in (mining) before it is optimal to do so, according to Bergstrom (1984)

royalties ($H^{\phi} > H^{\psi}$), which has a direct relationship with the abandonment trigger ($\Theta^{\phi} > \Theta^{\psi}$). In turn, the government is worse off ($\Gamma^{\phi} < \Gamma^{\psi}$), and so its decision to expropriate is accelerated. The smaller royalty fee partly offsets the higher expropriation risk generated by the government, because royalties generate a larger distortion than other taxes in the abandonment decision. This is consistent with the results in Jensen and Johnston (2011), where firms with a lower tax burden are more willing to invest, but at the same time, expropriation is more likely to happen.

Table 3.5: Cost measures: Expropriation *with* or *without* incentives?

	Θ^j	H^j	Γ^j	Ω^j	Θ_0^j	H_0^j	Γ_0^j	Ω_0^j
Tax cut	1,3%	1,2%	-1,8%	-0,32%	-2,18%	-4,72%	1,16%	-1,32%
Lower royalty	3,13%	1,88%	-2,12%	-0,15%	-2,16%	-4,91%	1,16%	-1,45%
ITC	0%	0%	0%	0%	-2,19%	3,13%	-0,88%	0,69%

As for the value of the investment opportunity, we observe that incentives intended for the stage of operations imply a decrease in the firm's investment option value ($H_0^{\phi}, H_0^{\psi} < 0$), and are thus associated with the biggest reduction in investment timing ($\Theta_0^{\phi}, \Theta_0^{\psi} < \Theta_0^{s}$). Notice that the higher the risk (a lower ε^j), the lower the value of the investment opportunity. This induces an acceleration of the decision to invest (see Restrepo et al. (2015)). However, subsidies applied at the moment of investment, which are not associated with additional discounting due to political risk, are the ones accelerating the most the decision to invest, and generating an increase in the value of the investment opportunity. Thus, the smaller investment trigger is solely a consequence of the incentive offered to the firm.

Related with the results above, note that there is a welfare loss for the case in which the government offers incentives that are intended to improve results at the stage of operations ($\Omega_0^{\phi}, \Omega_0^{\psi} < 0$), associated with a larger political risk. Therefore, it seems that if expropriation risk is imminent and the institutional weakness cannot be corrected, an incentive that does not exacerbate the threat to expropriate is more convenient for the economy as a whole. This conclusion is supported by the results of the ITC, where there is an increase in overall value change: the loss in government's value generated by a lower fiscal revenue is smaller than the gain in value for the private firm.

As for the effect of fiscal variables, we find that both royalties and taxes have a positive impact on the expropriation trigger. When they increase, the larger fiscal revenue that the government obtains leads it to postpone expropriation. However, at the same time, the abandonment trigger increases and the value of the firm at operations decreases. This means that although the firm bears less risk, the reduction in the post-tax income offsets the effect that lower expropriation risk has in the firm's results. The government value function follows a similar dynamics as in the benchmark case, so we also observe a Laffer curve for royalties and for taxes. Figures 3.2 and 3.3 show the evolution of the value functions of the government[11]. There are several points to notice in the graphs:

- The royalty rate and the tax rate that maximize government's value for all types of incentives is considerably smaller than in the case of no risk. For example, the maximum government value is reached when royalties are shortly below 40%, when in the safe case this happened when royalties were about 60%.
- With high k_v, the government can increase taxes and royalties somewhat further before it reaches the maximum rate. This means that even if the government is worse at expropriation by having to pay a higher compensation to the firm, the results at operations are good enough to offset this loss at expropriation.
- The more evident curvature of government's value when taxes (τ) change indicates that the marginal fiscal revenue is higher for every 1% increase in the corporate tax rate.

[11] Initially, we assume that the government offers to pay an indemnity $k_v = 0.5V(x_0)$ to the firm in case of expropriation. This implies that the indemnity value varies with taxes and royalties. Therefore, in order to assure that the dynamics of this exercise is only picking up the effect of taxes and royalties, we set the indemnity payment to a fixed value. Medium-low refers to $k_v = 5$, which is around 40% of the value of the firm in the safe case, and medium-high refers to $k_v = 9$, close to 80% of $V(x_0)$.

Figure 3.2: Varying royalties and taxes, medium-low k_v

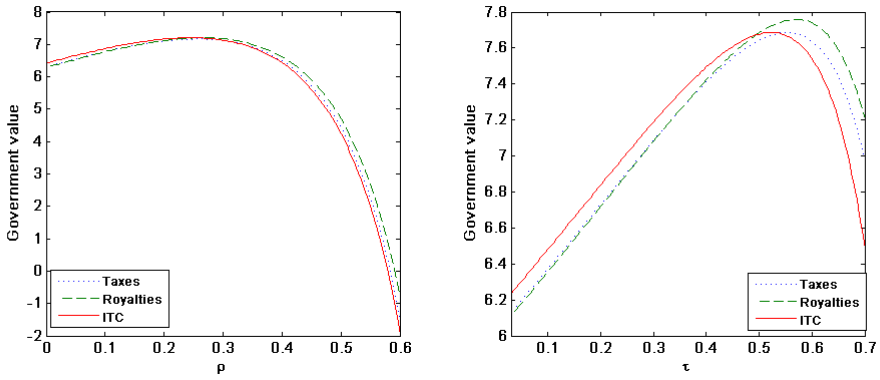
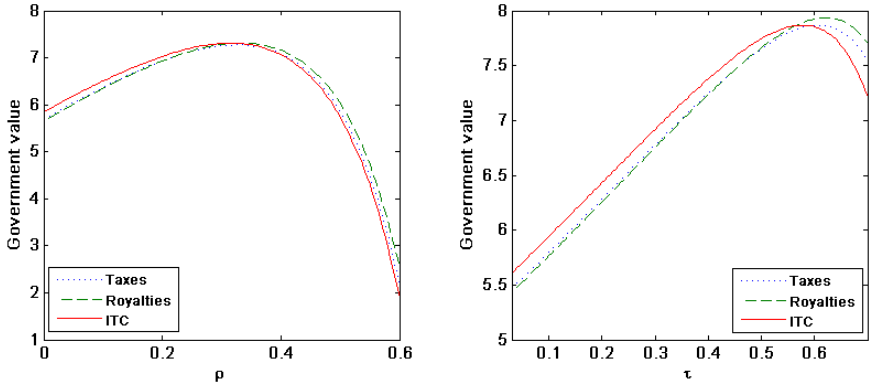


Figure 3.3: Varying royalties and taxes, medium-high k_v



Safe vs. Risky: Which incentive is better?

Table 3.6 shows the results for the second set of comparisons. Both ex ante and ex post, the firm is worse when there is expropriation risk ($H^j > 0$). In turn, the government is better off ($\Gamma^j > 0$) due to the value of the expropriation option, which enhances its claim on the business. The combined result, however, is a reduction in overall value ($\Omega^j < 0$): the large increase in government value is not enough to offset the negative results obtained by the firm, and so the economy is worse off. Also notice that the order of results observed in the previous section also holds in this case: the firm is better off with the ITC at the investment stage, and this is related with the smallest welfare loss for the economy.

Table 3.6: Cost measures: Safe without incentives vs. Expropriation with incentives

	Θ^j	H^j	Γ^j	Ω^j	Θ_0^j	H_0^j	Γ_0^j	Ω_0^j
Tax cut	-23.25%	-45.33%	130.19%	-11.71%	-2.56%	-170.62%	322.81%	-31.5%
Lower royalty	-21.86%	-44.97%	129.45%	-11.55%	-2.54%	-170.74%	322.82%	-31.59%
ITC	-24.23%	-45.98%	134.41%	-11.42%	-2.56%	-165.32%	314.28%	-30.1%

The implication of this result is that the first best for the economy would be a sound political environment, since the firm is not even close to being fully compensated by the fiscal mechanisms offered by the government in a context of expropriation risk. However, reaching a strong institutional environment is a lengthy and costly process. Therefore, to attract investment in the midst of such process, governments could offer fiscal incentives that do not exacerbate political risk –like lower taxes that suggest a large and unfair multinational take–.

3.5 Final remarks

It has been documented that countries with a sound institutional environment are more successful at this task than their counterparts offering less stable conditions. However, strengthening the institutional environment of a country is a task that may be very costly for a government, in terms of time and effort. Offering fiscal incentives to firms in order to compensate for a weak institutional and business environment is a strategy that offers more facilities to governments in their attempt to attract investment. The main goal of this paper is to analyze whether providing investment incentives to the firm in a context of expropriation risk is beneficial for the firm, for the government, and for the economy as a whole. In order to do that, we build a real options model that studies the decisions made by a private firm regarding the investment and liquidation decisions of a partially irreversible business, in a context in which an opportunistic government has the option to expropriate it. The decision to invest is contingent on the developments on operations, where the liquidation decision of the firm interacts with the expropriation decision of the government.

The purpose of this model is to answer three main questions. The first question asks which type of incentive is more beneficial for the firm. We find that in a politically safe environment the reduction in royalties provides the best results at operations for the firm. This is so because they have a more distortive nature than other taxes -like corporate income tax. Moreover, this result holds when we include risk: we find that the firm is more willing to take losses (abandonment is delayed), even though this type of incentive makes the government more prone to expropriation. However, if governments want to achieve an even earlier investment of the firm, then they should go for an incentive that does not imply higher political risk. The results of ITC prove so.

The second question asks whether offering incentives generates any improvements if expropriation risk is granted. That is, we want to establish if there is any improvement from a state in which there is expropriation risk and there are no benefits offered, to another one where the government compensates the firm for its threat to expropriate. The results show that the government loses value when the incentives offered impact only the investment decision of the firm, but the firm is better off, in such a way that the whole economy is better off. If the incentives are intended to affect the operational results of the firm, the firm's results improve, but the government's results deteriorate. When combined, the fall in government's value dominates the effect and there is a welfare loss.

Finally, the third question compares the outcomes when the government offers a safe institutional environment and no incentives to investment vs when there is an expropriation risk and firms are compensated for it. We find that although the government's value is always higher when there is expropriation risk, for the economy in general compensating the firm for a politically risky environment is never as good as creating a safe political environment: firms know that they will be expropriated sooner or later, and this will lead them to have a smaller scope to bear losses, which in this model is channeled through an early abandonment of the business. Thus, if governments aim at effectively attracting more investment, they should provide a sound institutional environment. Nevertheless, since achieving such state is a lengthy process, offering incentives that do not worsen political risk in the meantime could be the best option.

3.6 Appendix

Safe political environment

This section explains the conditions imposed on the general solution of ODE 3.3. These proofs are related to propositions 7, and 8. In this case, all the claims depart from the same principles. First, for the private firm and the government it must be that

$$\lim_{x\to\infty} = \frac{a}{\delta}x - \frac{b}{r} \tag{3.29}$$

This condition ensures that the value of the business does not go to infinity as x becomes sufficiently large, so that B_3 for $A = V, G$. Second, at the moment of abandonment of the private

firm, we have that, (i) for the private firm:

$$V^j(\hat{x}^j) = \lambda \tag{3.30}$$

where, λ is the residual value if the firm liquidates the business. (ii) for the government:

$$G^j(\hat{x}^j) = 0 \tag{3.31}$$

because if the private firm abandons, the government loses all its fiscal income.

The smooth pasting condition in this case is for the private firm, and from it we can determine the abandonment trigger in equation 3.8. This smooth pasting condition requires that the functions are matched not only in values but also in their slope, in particular,

$$\frac{\partial V(x)}{\partial x}\Big|_{x=\hat{x}^j} = 0 \tag{3.32}$$

Expropriation risk

In this case, the conditions imposed are at the moment of abandonment and expropriation for all agents $A = V, D, G$.

Private firm At the moment of abandonment, the firm will get the liquidation value (λ):

$$V_e^j(\hat{x_e}^j) = \lambda \tag{3.33}$$

If it is expropriated, the firm receives a compensation k_v from the government

$$V_e^j(\varepsilon^j) = k_v \tag{3.34}$$

Finally, the smooth pasting condition that allows for finding the abandonment trigger $\hat{x_e}^j$ in equation 3.16 is:

$$\frac{\partial E_e^j(x)}{\partial x}\Big|_{x=\hat{x_e}^j} = 0 \tag{3.35}$$

Government If the private firm abandons the business (and the cash flows never reached the expropriation trigger, ε^j, the government's claim on the business is zero, because it loses all fiscal income.

$$G_e^j(\hat{x_e}^j) = 0 \tag{3.36}$$

At the moment of expropriation, the government's value should be equal to what it starts earning from the business, minus its reputation and indemnity costs:

$$G_e^j(\varepsilon^j) = \frac{\varepsilon^j}{\delta} - \frac{c_g}{r} - k_v - k_r + \left(L - \frac{\hat{x^g}}{\delta} + \frac{c_g}{r}\right)\left(\frac{\varepsilon^j}{\hat{x^g}}\right)^{\beta_2} \tag{3.37}$$

The smooth pasting condition from which the expropriation trigger, ε^j, is obtained, ensures that at the moment of expropriation not only the values but also the derivatives of the functions are the same. This condition is given by:

$$\frac{\partial G_e^j(x)}{\partial x}\Big|_{x=\varepsilon^j} = \frac{1}{\delta} + \beta_2\left(\lambda - \frac{\hat{x^g}}{\delta} + \frac{c_g}{r}\right)\left(\frac{\varepsilon^j}{\hat{x^g}}\right)^{\beta_2}\left(\frac{1}{\varepsilon^j}\right) \tag{3.38}$$

After expropriation has occurred, the government owns the business, and it can liquidate it when it is no longer profitable ($x = \hat{x^g}$), receiving the residual value of the business, λ.

$$G_e^j(\hat{x_e}^j) = 0 \tag{3.39}$$

The abandonment trigger of the government comes from solving the smooth pasting condition

$$\frac{1}{\delta} + \beta_2\left(\lambda - \frac{\hat{x^g}}{\delta} + \frac{c_g}{r}\right)\left(\frac{1}{\hat{x^g}}\right) = 0 \tag{3.40}$$

Derivation of the value of the investment opportunity

The private firm The particular solution to the value of the investment opportunities presented in Propositions 9 and 13 comes from imposing certain boundary conditions. In particular, if there is no prospect of profit in the future, then the asset's worth will be zero. Therefore, $V(0) = 0$. Since $\beta_2 < 0$, to ensure that the value of the funci liketion goes to zero as x goes to zero, we set $B_2 = 0$. The constant B_1 arises from the fact that the value of the investment option must be equal ro the net value obtained by exercising it, i.e. $V_0(\tilde{x}) = V(\tilde{x}) - I$, where $I = Iv - S^j$, and $S^j = 0$ for $j \neq s$. Finally, the investment trigger is obtained through a smooth pasting condition that ensures that the functions of $V_0(x)$ and $V(x) - I$ should meet tangentially at $\tilde{x}$:

$$\frac{\partial V_0^j(x)}{\partial x}|_{x=\tilde{x}^j} = \frac{\partial V^j(x)}{\partial x}|_{x=\tilde{x}^j} \tag{3.41}$$

Government In order to obtain the value equations for the government in propositions 10 and 14, we also impose the condition that $B_2 = 0$ to ensure $G(0) = 0$. The value of the constant B_1 is obtained by noticing that at the moment of investment, it should be that $G_0(\tilde{x}) = G(\tilde{x}) - S_j$.

Chapter 4

The Impact of Expropriations on the Stock Prices of the Parent Companies: Sell on the rumor, buy on the news?

4.1 Introduction

We evaluate the economic impact of government expropriation of private property on the stock prices of the parent company. As far as we know, this article is the most thoroughgoing empirical research to date on this subject. Previous literature has focused on either one economic sector, like Shcherbakova (2010), who studies seven energy nationalization processes, or one country, as the analysis of equity transfers in China by Gao and Kling (2008).

We define an expropriation as the seizing, by the sovereign, of privately owned tangible property, with a view towards its continued operation (Truitt, 1970); in that sense, it is an act of a firm's *involuntary divestment*[1]. Still, expropriations are not illegal per se[2]. In fact, many countries have laws allowing the government the right to expropriate private property to address public issues, such as development or environmental matters. Therefore, as Sloane and Reisman (2004) point out, the "practice of eminent domain" is not likely to disappear. Even more, resource nationalism in the last decade has generated an increase in the number of expropriations occurring all over the world[3].

Although news on expropriation-related events are likely to generate a market reaction with respect to the stock prices of both parent and subsidiary companies, there is a lack of empirical evidence on this subject in extant literature. Our paper aims to fill this gap. We define two broad types of events. We distinguish between warnings and forced divestments. What we call pre-expropriation warnings relates to references to expropriation or nationalization publicly made by the government, but do not imply the definite loss of property or control rights over the production unit. These can be: (i) Announcements of nationalization, (ii) Announcements of expropriation, (iii) Occupations, (iv) Threats, and (v) Transitory permit revocations. Thereupon, warnings may be followed by several government actions. These are what we call forced divestments. We consider three types of government actions: (i) Outright expropriation, (ii) Forced sale and (iii) Permanent rescission of permit or concession. Our basic hypothesis is that expropriation-related events are bad news for future performance of parent companies and therefore their market value will decrease when these events are known. We make one exception in the case of

[1] Kobrin (1980) uses the term 'forced divestment' in order to group the different types of governments' seizing. In this section, we use the term expropriation to refer to any act of involuntary divestments indistinctly.

[2] According to Sloane and Reisman (2004), there seems to be a consensus in tribunals in that governmental conduct is determinant to define state responsibility in an expropriation action.

[3] It is worth noting that we do not study 'creeping' expropriation, which involves governments' increasing their take through taxes or other mechanisms, as these acts do not imply the loss of property or control rights of the firm.

forced sales, where we expect the market to have a positive reaction, due mainly to a correction of parent firms' valuation.

The event study methodology comes as a handy tool for this paper by providing a measure of stockholders' wealth change in the light of a given unanticipated event; see Brown and Warner (1980). In that fashion, if expropriation related announcements are to some extent unexpected, one should observe an abnormal market reaction. Whether this reaction anticipates the event, occurs during, or after the event, depends on the level of informational efficiency of the markets.

Specifically, we investigate the short-term impact of events related to government expropriation of private property on the stock prices of the publicly listed parent company by means of a unique database of 116 events in 12 countries from 2005 to 2013. Although our results should be read with caution given our small sample sizes for the individual event types, we find significant negative effects associated with several kinds of warnings; the larger effect is when the warning takes the form of a transitory revocation of a permit. In the case of forced divestments, we find a significant negative impact when there is a permanent revocation of a permit. However, stock prices react positively to forced sales. Thus empirical evidence supports our basic hypotheses in almost all cases.

Although it is not uncommon to find event studies relating stock market reactions to political events (e.g. Dube et al. (2011), Luechinger and Moser (2014)) there is relatively scarce literature on the effect of expropriations. Shcherbakova (2010) carries out an event study on the market impact of eight high profile regulatory events in the energy sector: nationalization and denationalization decrees. These events affect firms operating in Russia, Venezuela and Bolivia. Her results show that negative events (nationalizations) generate abnormally low returns, while the one positive event in her sample generates abnormally high returns. However, there are some problems in the definition of at least one event[4], and she centers the estimation window for normal returns on the expropriation event date. This decision is problematic because it rules out the possible impact of information leakages or previous announcements. Besides that, the event would affect not only the abnormal returns, but also the normal returns (MacKinlay, 1997).

Gao and Kling (2008) analyze the market reactions to equity transfers in China. They categorize equity transfers into four categories, including privatization and nationalizations, understanding these as the stock transfer from the State to a legal person or vice versa. They find that while privatizations have positive effects on returns of the privatized firm, the stock market perceives nationalizations as a bad signal for future stock performance. Nevertheless, since they only analyze the announcement of stock transfers, it is not possible to know whether these nationalizations occurred as a forced divestment or as a voluntary action executed by the firm.

This paper is organized as follows. In Section 4.2, we define the type of events that we study, and hypothesize about their effect on the parent firm's stock price. We describe the event study methodology in Section 4.3 and set up the framework for the selection of events and data in Section 4.4. Empirical results and robustness are presented in Section 4.5, while Section 4.6 shows possible variables explaining the cumulative abnormal returns. Section 4.7 concludes the paper.

4.2 Definition of events: warnings and forced divestments

In this section, we define all the events considered in the paper and hypothesize about their likely effects on the stock prices of parent firms. We start by stating the obvious: The expected effect of expropriations on the value of the parent firm is negative. This happens because in many occasions, governments may not compensate the parent firm, and even if they do, such indemnity may be below fair value. Besides, although it is true that parent firms may start a legal arbitration in international courts against the expropriator governments, it is also true that: (i) these processes are far from being inexpensive, and (ii) the governments, as sovereign entities, may choose not to indemnify the demanding firm, even if the court rules so.

However, there may be many governmental actions related to an expropriation. In this paper, we separate the expropriation-related events into two categories (i) pre-expropriation warnings,

[4]For example, in the case of the second oil nationalization in Venezuela, there is an additional phase for firms to conclude the forced sale to PDVSA. Shcherbakova (2010) did not consider this stage.

and (ii) forced divestments[5]. What we call pre-expropriation warnings relates to references to expropriation or nationalization publicly made by the government, but do not imply the definite loss of property or control rights over the production unit. Thereupon, warnings may be followed by several government actions. For example, after an expropriation threat, the firm's assets may be seized later on. We name the actions leading to the effective loss of rights over the business as forced divestments. By differentiating between these two broad categories, it is possible to determine the extent to which the market considers the warnings as credible signals and whether they can be useful to anticipate the forced divestments. Below, we define each type of action and discuss its expected effects.

4.2.1 Pre-expropriation warnings

In general, we expect pre-expropriation warnings to have a negative impact on the value of the parent firm, even if the warning does not imply the immediate loss of its property/control rights over the facility. The reason for this is that warnings can be interpreted either as credible signals of future expropriation, or as a way to put pressure on the firm to increase government's influence. We describe the five types of warnings below, as well as their possible effect on the parent firms' stock returns.

Announcements of nationalizations

These may refer to: (i) The government pursuing a broad policy within a given industry or sector, affecting more than one firm[6], (ii) The government announces its intention of taking over a given firm and establishes a deadline to negotiate its fair value.

The effect of this type of event on stock prices of the parent company is far from clear. On the one hand, in the end, the announcement may not materialize. On the other hand, if it does materialize, a nationalization process may end up as an outright expropriation if both parties are not able to come to an agreement, or as the complete opposite: a satisfactory negotiation process for both parties. Overall, the uncertainty about the outcome of the announcement (no action, negotiation, expropriation) makes it difficult to ascertain the definite result. Therefore, an attitude of 'wait and see' may be a reasonable market response.

Hypothesis 1a. *Announcements of nationalizations do not have clear effects on the stock price of parent firms*

Announcements of expropriations

In these cases, the government addresses its action towards a particular firm, or set of firms, without a nationalization decree backing up the decision, or simply commanding the forceful possession of the firm's assets. Expropriations are unilateral decisions made by the government, and compensation for the expropriated assets may seem an unlikely outcome. If the stock market considers these announcements as credible, its reaction towards the parent's company value is likely to be negative.

Hypothesis 1b. *Announcements of expropriations affect negatively the stock price of parent firms.*

Occupations

Occupations refer to events in which the government orders the intervention of the plants without previous notice. Since an occupation can be temporary (common in Venezuela), unless it comes with an explicit announcement of assets to be seized, an occupation is not considered an expropriation[7]. These may have a negative impact on the parent firm's stock returns for two

[5] We borrow this term from Kobrin (1980), in order to avoid confusion between outright expropriation and nationalization.

[6] For a brief illustration of the phases of a nationalization process, see Figure 4.5 in the Appendix 4.8.

[7] Whenever the announcements of occupation and expropriation coincided, the event was taken as an outright expropriation.

reasons. First, investors may interpret it as the clear intention by the government to seize the business. Second, it shows an unfriendly relationship between the government and the firm, at least from the sovereign side.

Hypothesis 1c. *Occupations have a negative effect on the parent firm's stock return.*

Threats to expropriate or nationalize

The government threatens publicly with either nationalization or expropriation. This threat may, or may not, be fulfilled afterwards. Threats should generate negative stock returns for the parent firms as well. If the threat is to expropriate, then it signals that the firm is under the government's watch. If the threat is to nationalize, it may not be as worrisome to investors, but it still predicts that the firm will operate under worse terms –that is, if it reaches an agreement with the government.

Hypothesis 1d. *Threats have a negative impact on the stock returns of the parent firms.*

Transitory revocation of permit

Either the permits necessary to operate a certain project are temporarily suspended or the government puts the renewal of the concession on standby. This action violates a previous renewal agreement. However, at this stage, the government has not made any resolution regarding the firm's assets.

This type of announcement implies a cease of activities for the subsidiary or project, and it is likely to generate a negative effect on the stock price of the parent firm due to: (i) a disruption of operating income, and (ii) the government signaling a desire either to increase its take, or to expropriate the firm/project (perhaps to sell it to a higher bidder). This effect may be especially large for some firms in the sample, which have a large dependence on the concessions being revoked.

Hypothesis 1e. *Transitory revocations of permits have a negative effect on the parent firm's stock returns.*

4.2.2 Forced divestments

Keeping in mind that expropriations are sovereign actions that parent companies may challenge on the courts, but without a guaranteed success, they are 'catastrophic' events[8] for parent firms. However, not all expropriation-related actions have the same degree of severity, so the stock market's reaction will likely differ from one type of action to another.

Forced sales

Forced sales usually involve an agreement between the firm and the government. Typically, a forced sale is the result of a negotiation process with the sovereign, in which a State Owned Enterprise (SOE) buys the privates' assets and pays a stipulated compensation. In this sense, we may interpret these actions as a *not-so* regular asset sale[9] by the parent company to the government. In general, voluntary asset sales are associated with positive mean excess equity returns on the day of the announcement (Clayton and Reisel, 2013). However, given the special characteristics of the deal, a forced sale might have two counteracting effects –one positive, and one negative. We argue that the combined impact of these two effects is likely to be positive. The negative effect is associated with an adverse market reaction: The transfer of assets may be set below fair value, so that the market punishes such unfair sale.

[8] We use this term based on the definition of catastrophe risk provided by Banks (2005): man-made or natural events that occur with low frequency and may result in substantial economic damage.

[9] In our sample, we deal mostly with asset purchases by the government, since many of the nationalized entities are projects or small firms directly controlled by a multinational, parent firm. If this were not the case, we should consider a different kind of acquisition.

The positive effect may be explained by two mechanisms. On the one hand, the government announces nationalizations with anticipation, and the process's results are uncertain. This uncertainty is likely to generate volatility in the relevant stock market before the government makes its decision to nationalize. In view of that, by the time of nationalization, the fact that such uncertainty is resolved may result in a positive market reaction –kind of a rebound effect–, especially if we consider that the market may have incorporated the possible expropriation into its valuation during the nationalization process. What is more, a nationalization implies that (i) there is a purchase –and not an asset seizure– made by the government, and (ii) since the firm's relationship with the government is still 'amicable', it lets the door open to new investment possibilities in the country[10].

Hypothesis 2a. *Forced sales have a positive effect on the parent firm's value.*

Outright expropriations

Outright expropriations differ in substance from forced sales. An outright expropriation is the forceful possession of the firm's assets by the government. Compensation may be sought by the firm, through lobby or litigation, or may be granted by the government in rather exceptional cases. However, there is no agreement regarding the asset transfer between the firm and the government before the expropriation. We categorize two types of events as outright expropriation:

(i) When a forced sale does not come to good terms, and the two parties do not reach an agreement.

(ii) Seizure of the firm's assets.

These events are the most catastrophic ones within our study, since they imply a total loss of property rights by the firm, in most cases without a fair compensation. Therefore, we expect the stock price of parent firms to experience a significant decline.

Hypothesis 2b. *Outright expropriations have a negative impact on the value of the parent firm.*

Permanent revocation of permits

These events happen in situations in which the firm had obtained a license to operate a facility for a specific time period, but the property rights over the facility have always belonged to the state (e.g. mining concessions). We refer to a permanent revocation of permits when the government sets a deadline to return the facility to the sovereign, violating a previous renewal agreement. We expect the stock market to react negatively towards these events. Although their effect may be similar to an outright expropriation, there is an important difference between both types of events: while outright expropriations refer to property rights, revoked concessions usually affect only control rights.

Hypothesis 2c. *Permanent revocations have a negative impact on the value of the parent firm.*

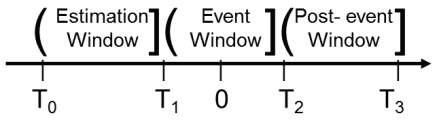
4.3 Event study set-up

In order to determine whether the stock price has an abnormal reaction to pre-expropriation warnings and forced divestments, we use the traditional event-study methodology, which estimates abnormal returns as out-of-sample predictions (see Brown and Warner (1980, 1985)). Figure 4.1 depicts the time-line of a traditional event study. The The first step is to specify the model generating normal or predicted returns: the returns an investor would expect to realize had the event not occurred (see Campbell et al. (1997), Brown and Warner (1980, 1985), and Kothari and

[10] As implausible as this may sound, there are cases of firms investing again in the host country, even if it had assets nationalized by the same ruling government. For instance, France's Total and Spain's Repsol, subject to Oil nationalization decrees in Venezuela, still operate in the country through new investments.

Warner (2007)). This benchmark is to be estimated within a period prior to the event –the estimation window–, excluding the event itself to provide estimators that are free of the influence of the event's effects. The estimation window should be long enough to capture the *normal* returns. Using the notation in Figure 4.1, the estimation window in our model is $[T_0, T_1] = [-245, -6]$.

Figure 4.1: Time line for an event study



There are several types of statistical models generating normal returns, like the constant mean return model, and the market adjusted return model (see MacKinlay (1997)). In this paper, we use the market model (eq. 4.1), which assumes the expected return of the security to vary both over time and across securities. It expresses the return on every security as a systematic risk component, which is a proportion β_i of the market return[11], $r_{m,t}$, plus a residual $u_{i,t}$ that is specific to the firm, and uncorrelated to the market[12] (Rosenberg, 1981).

$$r_{i,t} = \alpha_i + \beta_i r_{m,t} + u_{i,t} \tag{4.1}$$

After estimating normal returns, the *abnormal* performance of a stock is measured as the difference between ex-post and predicted returns during the event window; that is, we compute the error term as follows (out-of-sample basis):

$$AR_{i,t} = u_{i,t} = r_{i,t} - \hat{r}_{i,t} \tag{4.2}$$

then, CARs –cumulative abnormal returns– are calculated to account for the possibility that the event's effects develop over time. Therefore, we accumulate abnormal returns over the event window, $\tau = [\tau_1, \tau_2]$, where $T_1 \leq \tau_1 \leq \tau_2 \leq T_2$

$$CAR_{i,\tau} = \sum_{t=\tau_1}^{\tau_2} AR_{i,t} \tag{4.3}$$

At this point, there are two important issues to address. First, the event window length is a central question when setting up an event study, but despite its importance for the analysis, there is no general agreement among researchers on its proper length. MacKinlay (1997) suggests using $[-1, +1]$, but other windows are common. For example, Dube et al. (2011) use $[0, 15]$, Luechinger and Moser (2014) use $[0, 1]$, and Miyajima and Yafeh (2007) use $[-5, +5]$. As a baseline specification, we consider five days before the announcement and five days after the announcement –that is, the conservative $[-5, +5]$ interval[13]– because such specification allows for exploring whether the market is able to anticipate the events (by including in the analysis some days prior to the event) or if the market needs a few days to reflect the impact of the news on the market prices[14] (by including in the analysis some days after the event).

Second, using conventional inference methods in event studies poses a problem because stock prices are not normally distributed, and returns may be subject to cross sectional correlation (see Brown and Warner (1980, 1985), and Campbell et al. (1997)). This has led to the use of non-parametric tests, usually more powerful than their parametric counterparts in these cases. In

[11] Park (2004) suggests including exchange rates in eq. 4.1 for international event studies. Shcherbakova (2010) includes the oil price in eq. 4.1 to conduct her event study on oil firms. We do not include any additional variables, but we refine this specification using a sectoral index in order to control for sector-specific dynamics.

[12] We assume that $E[u_{i,t}] = 0$, since the unexpected returns in an efficient market cannot systematically differ from zero, and that $var[u_{i,t}] = \sigma^2_{i,t}$.

[13] Wider windows increase the probability of confounding events entering into the computation of CARs, which may generate a bias in the results. We exclude events from our sample that are subject to confounding events during the 11-day window, centered on the event day.

[14] The speed of the reaction of the market depends on the relative impact of the frictions to trade (liquidity, transaction costs, limits on short positions and so on), as well as the time the news on the event take to arrive in the home market.

order to establish the significance of cumulative abnormal returns, we use the Generalized Rank Test proposed by Kolari and Pynnonen (2011), which distributes asymptotically as a Student's t, with $T - 2$ degrees of freedom. The authors have shown this test to be robust to return serial correlation, event-induced volatility, and cross-sectional correlation resulting from clustering. However, because we deal with very small samples for some event types, we also calculate the test's exact distribution, building on the idea that percentile ranks distribute as uniform random variables over the interval $[0, 1]$ (Corrado and Zivney (1992), Dube et al. (2011)).

4.4 Data

4.4.1 Events

In order to define the events we study, we follow the approach proposed by Kobrin (1980, 1984). The author constructs the most comprehensive database of forced divestments acts to 1980 in order to analyze their determinants, accounting for political, legal, financial and economic factors[15]. Even though the aims and scope of our paper differ from those of Kobrin (1980), his framework to define an act of involuntary divestment is our starting point to define the events that we study[16].

In that sense, the first step to look for events of forced divestment is to determine the characteristics that define such an action. An event enters our sample if it has the three following characteristics. First, the divestment is involuntary and forced by the host government. Since our main purpose is to understand how firms react to political risk -particularly, expropriation risk-, which concerns the protection of property rights in the host country, we exclude firms that have been nationalized as part of any bail-out program. For instance, our sample does not include banks and financial firms nationalized because of the recent Global Financial Crisis. Second, the forced divestment directly affects the property or control rights, and not the benefits associated with operations. Therefore, we exclude 'creeping expropriation' from our sample. This means that the event of renegotiation of contracts only enters the database when it implies a threat to the firm's operations. Finally, the targeted property is privately owned by either national or foreign agents.

However, as explained in Section 3, we also analyze announcements or transitory actions associated with factual forced divestments. That is, we consider announcements, threats, temporary occupations and transitory permit revocations when they signal the government's intention to force a firm's divestment.

We obtained the events in our sample through an extensive news search mainly through Abi-Inform, which is a database that contains key business publications, with a large international coverage. However, in some cases it was necessary to complete the information with additional sources, such as firms' press releases, and local newspapers. Our baseline data, presented in Table 4.1, includes 116 events, involving 70 publicly traded firms whose operations resulted threatened and/or affected in 12 countries between 2005 and 2013. Venezuela and Bolivia account for the majority of cases, with 54.3% and 13.8% of the total number of events[17].

Table 4.2 presents the results in terms of industry sectors for the total sample, pre-expropriation warnings and forced divestments. Although our results are not directly comparable to other studies on expropriations (e.g. Kobrin (1980), Minor (1994) and Hajzler (2012)), the figures obtained for the group of forced divestments offer some insight on the evolution of the industries that have been historically affected by expropriation-related actions. In our sample, between 2005 and 2013, more than 50% of the events are related to mining and oil services (ICB codes

[15] His work was extended by Minor (1994) and Hajzler (2012).

[16] However, there are two differences between Kobrin's definitions and ours: (i) he accounts for cases in which non-governmental agents force divestments, but we consider governmental agents only, and (ii) an event enters his sample only if it regards targeted foreign property, but we consider also local property.

[17] Our baseline data includes only 116 events because we excluded firms affected by confounding effects: events unrelated to those in our sample that may affect the parent firm's stock price and bias our results (see McWilliams and Siegel (1997), MacKinlay (1997)). Appendix 4.8 presents a frequency table of events by type that accounts for all the events affected listed firms that we found while conducting this research.

Table 4.1: Events by type

Event type	Frequency	Proportion of the Total
Announcement of nationalization	37	31.9
Announcement of expropriation	1	0.86
Occupation	11	9.48
Threat	22	18.97
Revocation of permit	6	5.17
Pre-Expropriation Warnings	**77**	**66.38**
Outright expropriation	21	18.1
Forced sale	14	12.07
Permanent Rescission of Contract	4	3.45
Forced divestment	**39**	**33.62**
Total sample	**116**	**100.00%**

0001 and 1000) while the average of acts[18] affecting firms in these sectors between 1960 and 2006 is close to 30%. Forced divestments of firms associated with utilities account for 23.08% of the cases that we study, well above the 8.8% average registered between 1960 and 2006 (Hajzler, 2012). The fact that these trends still hold goes in line with the two main explanations presented in Kobrin (1980) to understand why these sectors are such popular targets for host governments. On the one hand, communications and utilities are considered key to national security. On the other hand, extractive industries are attractive targets if the economy largely depends on them, as in the cases of Venezuela, Bolivia and Zimbabwe.

Table 4.2: Frequency of events by ICB industry

		All		Pre-Exprop. Warnings		Forced divestments		FD/W
Industry	**ICB code**	**Abs.**	**Rel.**	**Abs.**	**Rel.**	**Abs.**	**Rel.**	
Oil & Gas	1	41	35.34%	30	38.96%	11	28.21%	35.43%
Basic Materials	1000	27	23.28%	17	22.08%	10	25.64%	58.82%
Industrials	2000	13	11.21%	8	10.39%	5	12.82%	62.50%
Consumer goods	3000	7	6.03%	6	7.79%	1	2.56%	16.67%
Health care	4000	0	0.00%	0	0.00%	0	0.00%	0.00%
Consumer Serv.	5000	0	0.00%	0	0.00%	0	0.00%	0.00%
Telecom	6000	3	2.59%	1	1.30%	2	5.13%	200%
Utilities	7000	16	13.79%	7	9.09%	9	23.08%	107%
Financials	8000	9	7.76%	8	10.39%	1	2.56%	12.50%
	Total	**116**	**116**	**100%**	**77**	**100%**	**39**	**100%**

Another way to assess the importance of these sectors for host governments is to determine the proportion of warnings in each sector that materialized into forced divestments. The last column in Table 4.2 shows the materialized warnings as a percentage of the total warnings. In other words, it represents the number of forced divestments preceded by warnings, as a proportion of total warnings. On average, this proportion is close to 50%. Although these results may have some caveats[19], we may see that for firms in the financial sector (ICB 8000), only 12.5% of the warnings were followed by forced divestments. In contrast, communications (ICB 6000) and utilities (ICB 7000) are associated with a large proportion of warnings ending up as effective forced divestments. Firms pertaining to Oil & Gas sector (ICB 1000) display a relatively lower proportion[20], whereas Basic materials and Industrial are above average. In the case of the Oil & Gas industry, a possible explanation of the relatively low figure is the nature of the deals made by host governments in this sector: oftentimes, they would aim for a controlling stake, instead of a 100% stake[21].

4.4.2 Stock prices and market data

We use log-returns on the stocks' total return index provided by Data Stream, which controls for dividends. Regarding the market variables, since we deal with stocks from all over the world, we calculate the market returns $r_{m,t}$ on the index provided by DataStream for each market. These

[18] An act is defined by Kobrin (1980, p. 72) as "the forced divestment of any number of firms in a single industry in a single country in a given year", and this is the definition followed by Minor (1994) and Hajzler (2012).

[19] Since we do not have the universe of pre-expropriation warnings and forced divestments, it may be the case that some of the warnings that we analyze ended up as forced divestments, without being included in our sample.

[20] The big exception was Libya, where the civil unrest started almost just after the government threatened to nationalize the oil sector.

[21] In the oil sector nationalization processes in Venezuela, for example, the announcement affected all the operating firms, but the actual nationalization (transfer of shares) only affected those firms with controlling stakes in the projects.

are value-weighted indexes for each stock market. The reason for using data from the home market of the parent company is that usually the stocks are more liquid there than in other exchanges, due to the well-known "home-bias" effect.

4.5 Results, robustness and sub-samples

4.5.1 Baseline results: Reaction of the stock market

In this section, we present CARs by type of event, using the methodology described in Section 4.3: CARs (equation 4.3) are computed by estimating the model given by equation 4.1, using Datastream local market index. As for the event window, we consider several specifications. First, we assume that the market does not anticipate the events. This is tested with the [0, 0] and [0, 5] windows; the latter accounts for the possibility that the market needs an extended learning period, while the first one assumes that the market immediately digests all relevant information on the event day. Next, we allow for the market to anticipate the event, so that abnormal returns appear a few days before the event. Therefore, we use the [-5, 0] and [-5, 5] windows.

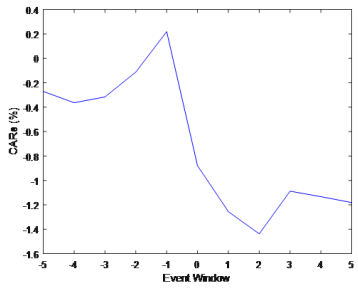
Table 4.3 presents mean CARs as predicted from the model in equation 4.1. We find that, overall, expropriation-related events, generate an average significant loss of 1.09% on the event day, and that the market keeps learning about these events, as the loss accumulates to a significant 1.41 % five days after the events. However, we do not find evidence of market anticipation because losses on the [-5, 0] and [-5, 5] windows are below the ones in the [0, 0] and [0, 5] windows. This is corroborated in Figure 4.2, since the biggest losses are observed after the event has occurred[22].

Table 4.3: Average CARs, traditional methodology

Event type	CAR window				Events
	[0,0]	[0,5]	[-5,0]	[-5,5]	
Full sample	**-1.0979%***	**-1.4001%****	-0.88%	**-1.1811%***	116
Pre-expropriation warnings	**-1.0130%***	**-1.9591%*****	-0.44%	**-1.3872%*****	77
Ann. Nationaliz.	-0.21%	1.19%	0.71%	2.11%	37
Ann. Exprop.	-2.42%	-11.28%	7.01%	-1.86%	1
Occupation	0.17%	-2.01%	-0.14%	-2.32%	11
Threat	**-2.0525%***	**-3.9548%*****	-2.15%	**-4.0478%****	22
Transitory Revocation	**-4.6808%****	**-12.4701%****	**-4.1086%****	**-11.8978%*****	6
Forced Divestments	-1.27%	-0.26%	-1.82%	-0.81%	39
Expropriations	-2.09%	-2.07%	-2.67%	-2.65%	21
Forced Sales	0.11%	**2.5520%***	**1.4041%***	**3.8423%*****	14
Permanent revocation	-1.99%	-0.70%	**-10.0456%*****	-8.75%	4

Note: Average CARs obtained from estimation of equation (1), excluding from the sample log returns with absolute value above 40%. Significance levels of 10%, 5%, and 1% are identified by *, **, and ***, respectively, and are based on the Generalized Rank T-test proposed by Kolari and Pynnonen (2011), using the asymptotic distribution of the test, and confirming these results by the means of its exact distribution.

Figure 4.2: Average CARs: Full sample



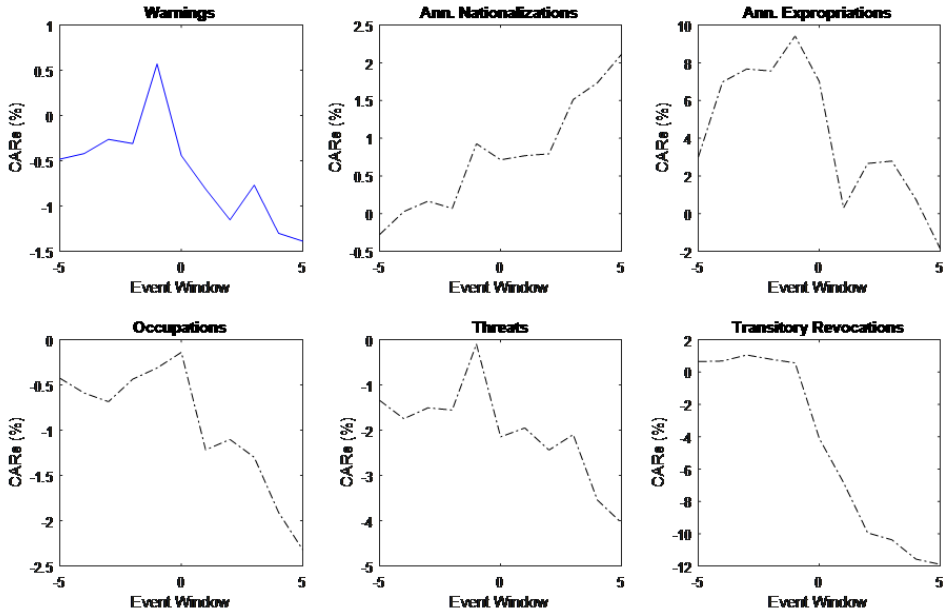
Note: Cumulative abnormal returns from estimation of equation 4.1, excluding from the sample log returns with absolute value above 40%. Event window centered in the event date.

[22] A look at Figure 4.2 suggests exploring the possibility that the market anticipates these news only one or two days before the event. Although not reported here, the results for event windows of [-2, 0], [-2, 2] and [-2, 5] do not show a significant anticipation effect either.

When we analyze by type of event, we find that pre-expropriation warnings convey a borderline significant loss of 1.01% on the event day that increases to a significant 1.96% over a five-day period. Disaggregating warnings, our results seem to support Hypothesis 1a, since we find that *announcements of nationalization* do not have clear effects on the stock price of parent firms. As for Hypothesis 1b, although we cannot provide significance levels for the only announcement of expropriation left in our sample, there are signs of the market reacting negatively on the event day and continuing to learn about it over a five-day period. Graphical inspection of the CARs in Figure 4.3 agrees with this result; what is more, it suggests that the *expropriation announcement* came as a big surprise for the market. Hypothesis 1c, that *occupations* have a negative effect on the parent firms' stock returns, is not supported by our data, although the CARs do move in the expected direction, as confirmed by Figure 4.3. This may suggest that occupations are not taken as credible threats by the market.

Hypothesis 1d is supported, since *threats* imply a borderline significant loss of 2.05% on the event day that adds up to a significant 3.96% loss when we allow for an extended learning period. Finally, Hypothesis 1e goes in line with the results observed for *transitory permit revocations*, which are associated with a large and significant market response: on the event day, the mean fall in parent firms' stock prices is 4.68%, and the loss keeps growing to a significant 12.47% five days after the revocation of the permit. Although losses on the [-5, 0] and [-5, 5] windows are significant, they provide little evidence of the market anticipating the event, when we compare their CARs magnitude with the [0, 0] and [0, 5] windows. This is consistent with the evolution of CARs presented on the rightmost panel of Figure 4.3.

Figure 4.3: Average CARs: Pre-expropriation Warnings, by type of event



Note: Cumulative abnormal returns from estimation of equation (1), excluding from the sample log returns with absolute value above 40%. Event window centered in the event date.

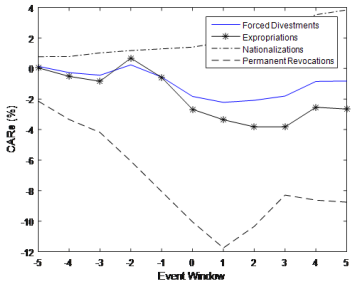
Forced divestments as a whole are not significant. Analyzing each type of forced divestment, we find that *forced sales* do not generate significant abnormal returns on the event day, but are associated with a borderline significant gain of 2.55% that accumulates over five days after the event day (i.e. [0, 5] window). Anticipation of the event also plays an important role: there are significant mean gains of 1.40% and 3.84% that appear when we calculate CARs for the [-5, 0] and [-5, 5] windows. Figure 4.4 lets us appreciate this dynamics more clearly: there is a clear positive trend for the CARs during the event window. This is consistent with Hypothesis 2a: in view of the catastrophic alternative of an expropriation, the fact that the parent firm can close a

deal with the government to sell its assets may seem quite a positive result to market participants. Besides, anticipation is a plausible result if we consider that information leakages may arise from the company's side, since it is its decision to accept the government's deal at last.

Outright expropriations do not have a significant impact on the stock price of the parent firms, although the graphic evolution of CARs in Figure 4.4 shows a small negative cumulative market response around the event day. This means that Hypothesis 2b is not supported by our data, which is somewhat puzzling, since the nature of the event implies the loss of property or control rights over a facility, and thus its expected future stream of cash flows –let alone the high probability of obtaining no compensation for the subsidiary-. However, taking a closer look to the sample of outright expropriations, only 5 out of our 14 events are what we could call "surprising expropriations": they were not associated with previous warnings by the host government. This suggests that the information may have been incorporated by the time the expropriation finally occurred.

Finally, permanent rescissions are associated with negative effects in all cases, but only convey a significant loss of 10.05% over the [-5, 0] window, meaning that the market largely anticipates the event, but that its effect over the stock price vanishes quickly from the market, as Figure 4.4 seems to imply. Thus, we find some support for Hypothesis 2c.

Figure 4.4: Average CARs: Forced Divestments, by type of event



Note: Cumulative abnormal returns from estimation of equation (1), excluding from the sample log returns with absolute value above 40%. Event window centered in the event date.

In summary, at the aggregate level we find that expropriation-related events are associated with a significant loss on the event day. However, we do not find evidence of the market anticipating the events. In the case of warnings, there is a significant loss on the event day that increases twofold over a five-day period. Disaggregating warnings, we find some support for Hypothesis 1a, 1d and 1e, but the support is less clear in the case of Hypothesis 1c. The group of forced divestments does not have a significant effect. Analyzing each type, we find that the results for forced Sales are consistent with Hypothesis 2a, and the results for permanent rescissions are consistent with Hypothesis 2c. However, the results for outright expropriations do not support Hypothesis 2b.

4.5.2 Robustness checks

Alternative methodology

In order to test whether our results are subject to the methodology we have employed, we use an alternative specification motivated by Dube et al. (2011), which captures the abnormal returns as a shock to the parent firm stock returns. The model we estimate is:

$$r_{i,t} = \alpha_i + \beta_i r_{m,t} + \gamma_e E_{i,t}(k) + u_{i,t} \tag{4.4}$$

Where $r_{i,t}$ is the return on firm i's stock price, $r_{m,t}$ is the return on the market index[23], and $E_{i,t}(k)$ is an indicator variable that takes the value of one during the k-day length event window, and zero

[23]The regression estimated by Dube et al. (2011) includes four Fama-French factors. In our setting, however, we restrict the model to include only the market index. The reason is that data for the four-factor Fama-French model are available only for U.S. firms, whereas our sample contains parent firms based in several countries.

otherwise[24]. In that fashion, this model lets parameter γ_e measure the average daily abnormal return over the k-day period, for event type e, as a transitory shock to the process. The cumulative abnormal return is then computed as $k\gamma_e$. As in the case of the traditional methodology, we consider different specifications for the CAR period, for t ranging between -5 and 5, with zero representing the event day. Equation 4.4 is estimated for a window $t \in [-245, 25]$.

Table 4.4 presents the results of the estimation of Equation 4.4 for each event category, as well as for the whole sample. We can appreciate that the events effects are virtually the same as in the traditional event study methodology. Furthermore, given the setting of the model in equation 4.4, we can now supply some significance for the effect of the *announcement of expropriation* in our sample: in line with the results observed in Figure 4.3, the event comes as quite a shock to the market on the announcement day, with a significant loss of 2.39% that keeps accumulating during five days after the event. Thus, we can now talk about a partial support for Hypothesis 2b, with a careful reading of the result[25].

Table 4.4: Average CARs, alternative methodology.

Event type	CAR window				Events
	[0,0]	[0,5]	[-5,0]	[-5,5]	
Full sample	**-1.1027%****	**-1.4688%***	-0.91%	-1.27%	116
Pre-expropriation warnings	**-1.0430%****	**-2.0575%****	-0.52%	-1.54%	77
Ann. Nationaliz.	-0.25%	1.09%	0.64%	2.02%	37
Ann. Exprop.	**-2.3909%*****	**-11.7468%***	7.27%	-1.97%	1
Occupation	0.17%	**-2.1499%***	-0.21%	-2.58%	11
Threat	-2.09%	**-4.1632%***	-2.29%	**-4.4034%***	22
Transitory Revocation	**-4.6796%****	**-11.7874%*****	-3.43%	**-11.3383%****	6
Forced Divestments	-1.22%	-0.27%	-1.71%	-0.72%	39
Expropriations	-2.00%	-1.88%	-2.19%	-2.06%	21
Forced Sales	0.11%	**2.3411%****	1.29%	**3.5463%****	14
Permanent revocation	-2.00%	-0.47%	**-10.1934%****	-8.75%	4

Note: We calculate average CARs as $k\gamma_e$ from the estimation of equation 4.4, using Data Stream market index and robust standard errors. Significance levels of 10%, 5%, and 1% are identified by *, **, and ***, respectively, and based on the largest between robust and cluster standard errors. We exclude from the sample log returns with absolute value above 40%.

The fact that the results obtained through both methodologies are so similar seems to confirm that expropriation actions do affect the stock price of parent firms, and that different types of actions imply different reactions of the stock market. Of particular interest is the effect of *forced sales* on stock prices of parent firms, which so far has been thought to be negative (e.g. Shcherbakova (2010)). The possibility of the firm coming to an agreement with the government towards the sale of its stake in the host country sends the market a positive signal: in spite of possible delays in the payment, and a transfer of assets below fair value, it is much more positive than the catastrophic alternative of an expropriation.

Time-Shifted placebos

In order to make sure that the significance of our results is not a mere coincidence, in the fashion of Dube et al. (2011) and Luechinger and Moser (2014), we shift our events 20, 40, and 60 days backwards and then estimate the market model (equation 4.1). Table 4.5.2 presents the results for the 1-day and 11-day windows. Except for *permanent revocations*, none of the CARs associated with our event types are significant –even at the 10% level. A closer look at the case of permanent revocations, where we have three firms with four revoked permits, indicates that they were subject to several other events during these dates: negative earnings reports (Crystallex and Anglo-American PLC), transitory permit revocations (First Quantum Minerals), and generalized industry movements in the home country (Anglo American). Thus, these results seem to support that the CARs we find significant are a consequence of the events that we study and proves the importance of looking for confounding effects on the dates of interest.

[24] In principle, $E_{i,t}(k) = 1$ represents the case where the whole firm is at stake of being subject of forced divestment. Dube et al. (2011) interact the associated parameter γ_e by the value of the subsidiary relative to the parent firm to estimate the actual reaction of the market. However, given the difficulty to obtain accurate information on subsidiary value for our sample, we leave this issue for a posterior part of our research.

[25] The announcement of expropriation involved a Mexican food producer's operations in Venezuela, and it occurred after the firm had been subject to a previous occupation.

Table 4.5: Average CARs, alternative methodology.

Event type	−60 days shift		−40 days shift		−20 days shift	
	[-60,-60]	[-65,-55]	[-40,-40]	[-45,-35]	[-20,-20]	[-25,-15]
Pre-Expropriation Warnings						
Ann. Nationaliz.	-0.3505%	1.4111%	-0.3984%	0.6655%	0.0869%	2.2340%
	(0.69)	(0.91)	(0.19)	(0.66)	(0.63)	(0.89)
Ann. Exprop.	-2.3789%	-1.9342%	2.0125%	-1.0626%	-0.2278%	0.0409%
	–	–	–	–	–	–
Occupation	0.4208%	2.8162%	-0.4702%	-1.0688%	-0.6245%	-0.1200%
	(0.31)	(0.91)	(0.11)	(0.21)	(0.15)	(0.62)
Threat	1.2549%	4.0360%	0.5789%	-1.8096%	-0.2148%	1.0899%
	(0.93)	(0.92)	(0.83)	(0.12)	(0.36)	(0.48)
Transitory Revocation	0.4588%	-1.8241%	-0.4756%	1.7809%	1.7343%	-2.8945%
	(0.68)	(0.5)	(0.66)	(0.36)	(0.9)	(0.14)
Forced Divestments						
Expropriations	-0.7474%	-1.8682%	0.3045%	1.5654%	0.9031%	-0.3610%
	(0.31)	(0.29)	(0.57)	(0.29)	(0.56)	(0.52)
Forced Sales	0.1847%	1.5813%	-0.3593%	-2.3812%	-0.3411%	-0.2293%
	(0.31)	(0.12)	(0.69)	(0.99)	(0.92)	(0.9)
Permanent revocation	-0.3004%	**-6.9791%*** **	0.9999%	-0.5880%	-1.0564%	**-5.8745%*** **
	(0.21)	(0)	(0.51)	(0.78)	(0.11)	(0)

Note: Average CARs obtained from estimation of equation 1. We use an estimation window of [-245,-130], and exclude from the sample log returns with absolute value above 40%. P-values in parentheses. Significance levels of 10%, 5%, and 1% are identified by *, **, and ***, respectively, and are based on the Generalized Rank T-test proposed by Kolari and Pynnonen (2011), using the asymptotic distribution of the test, and confirming these results by the means of its exact distribution.

4.5.3 The effect of Venezuela

Given the importance of Venezuela within our sample (more than 50% of the events), it is worth exploring to what extent results change once we exclude this country from the sample, as well as the dynamics of market reactions in Venezuela as separate case. Since Venezuela constitutes a unique scenario where expropriations were the order of the day, we expect the market to incorporate all the information regarding the expropriation risk facing firms that had operations in the country during the period we study. In that sense, this setting offers the perfect opportunity to check whether the market thinks of pre-expropriation warnings as credible threats. If that is the case, we should observe a larger abnormal market reaction towards pre-expropriation warnings than in the case of other countries.

Tables 4.6 through 4.9 present the results for the samples ex-Venezuela (tables 4.6 and 4.7), and Venezuela (tables 4.8 and 4.9), using both the traditional event study methodology and the alternative proposed by Dube et al. (2011). As before, very similar results are obtained through both methods, but in this case their statistical significance only coincides in some types of events.

In the ex-Venezuela sample, we do not find significant reactions from the market in the full sample or in the group of pre-expropriation warnings. In the latter group, only transitory revocations convey a significant loss of about 4.6% on the event day and that the market needs some time to adjust to the news, since the return accumulated over a five-day period is a significant -7.5%; this is the case for both methodologies, which suggests that our results are robust. In the case of forced divestments, permanent revocations convey a significant loss of around 5.6% during the event day, while Forced Sales are associated with a significant gain accumulated five days following the event, and over an 11-day window: there is both anticipation and learning for this type of event. This is consistent with the idea that there may be information leakages on the firm's willingness to close the deal with the host government.

In contrast with the results above, for the sample of Venezuela, we find that the set of pre-expropriation warnings generates a rather large abnormally negative market response. The results also suggest that the market takes some time in digesting the news, as the loss accumulates five days after the event. Besides, to some extent, there is anticipation as the loss is bigger for the [-5, 5] window than for the [0, 5] window. Disaggregating by type of event, although we cannot provide meaningful results based on the traditional methodology for transitory revocations and announcement of expropriation (there is only one of each left in our sample), the alternative methodology suggests that these are highly significant. For the case of the expropriation announcement, the results suggest that it comes as a surprise for the market, which requires some time to fully digest the news, since the returns for the [-5, 0] and the [-5, 5] windows are

Table 4.6: Traditional Methodology, Rest of the world

Event type	CAR window				Events
	[0,0]	[0,5]	[-5,0]	[-5,5]	
Full sample	-1.14%	**-1.4786%***	0.04%	-0.30%	68
Pre-expropriation warnings	-0.53%	**-0.8136%****	1.09%	0.81%	53
Ann. Nationaliz.	-0.13%	1.91%	2.88%	4.92%	14
Ann. Exprop.	n.d.	n.d.	n.d.	n.d.	0
Occupation	0.47%	**-2.7100%*****	**2.9358%****	-0.24%	2
Threat	0.25%	**-0.8218%***	0.63%	-0.44%	17
Transitory Revocation	**-4.6808%****	**-7.5343%****	**-3.2860%****	**-6.1395%*****	5
Forced Divestments	-2.67%	-3.20%	-2.72%	-3.25%	15
Expropriations	-3.29%	-7.04%	-3.65%	-7.40%	9
Forced Sales	0.16%	**9.2833%***	2.64%	**11.7666%***	4
Permanent revocation	**-5.5801%*****	-3.91%	**-10.2138%*****	**-8.5411%***	2

Note: Cumulative abnormal returns from estimation of equation 4.1, excluding from the sample log returns with absolute value above 40%. Event window centered in the event date. Significance levels of 10%, 5%, and 1% are identified by *, **, and ***, respectively, and are based on the Generalized Rank T-test proposed by Kolari and Pynnonen (2011), using the asymptotic distribution of the test, and confirming these results by the means of its exact distribution.

Table 4.7: Alternative Methodology, Rest of the world

Event type	CAR window				Events
	[0,0]	[0,5]	[-5,0]	[-5,5]	
Full sample	-1.12%	-1.49%	-0.02%	-0.35%	68
Pre-expropriation warnings	-0.55%	-0.88%	0.97%	0.66%	53
Ann. Nationaliz.	-0.17%	1.78%	2.71%	**4.7665%***	14
Ann. Exprop.	n.d.	n.d.	n.d.	n.d.	0
Occupation	0.48%	-3.20%	3.09%	-0.08%	2
Threat	0.24%	-0.87%	0.45%	-0.70%	17
Transitory Revocation	**-4.6796%****	**-7.4902%****	-3.29%	-6.12%	5
Forced Divestments	-2.56%	-3.14%	-2.64%	-3.04%	15
Expropriations	-3.07%	-6.92%	-3.10%	-6.97%	9
Forced Sales	0.09%	**7.6816%****	2.23%	**9.4728%****	4
Permanent revocation	**-5.6393%*****	-4.05%	-10.48%	-8.99%	2

Note: We calculate average CARs as $k\gamma_e$ from the estimation of equation 4.4, using Data Stream market index. Significance levels of 10%, 5%, and 1% are identified by *, **, and ***, respectively, and are based on the largest between robust and cluster standard errors. We exclude from the sample log returns with absolute value above 40%.

not significant, while returns for the [0, 0] and the [0, 5] windows are substantial and significant. As for the transitory revocation, the results suggest a large reaction from the market over the five days that follow the event, as well as some anticipation. Threats are also associated with large negative market responses that are significant, and suggest both learning and anticipation. These results are consistent with the idea that, given the history of forced divestments in this country, any warning made by the government regarding the possible involuntary divestment of a firm is interpreted by the market as a credible threat.

In the case of actual forced divestments, we find that the market anticipates the permanent revocation of permits for the two cases in our sample, since during the five days previous to the event and up to its occurrence, the loss is above 8.8% (for both estimations). There is a rebound effect because the return on the event day is a positive and significant 1.6%, but the rebound is not significant during the five days after the event.

4.6 Explaining CARs: The effect of sector vulnerability and political risk

Several variables may offer clues about the likelihood of an expropriation related event's occurrence, providing investors with valuable information. For example, as stated in Section 4, firms operating in some sectors are more likely to be forced to divest. In particular, Table 4.2 indicates that Oil & Gas, Basic materials, and Utilities sectors are the most vulnerable to forced divestments. This sectorial characteristic may shape investors reaction towards governmental measures related to forced divestments. In order to determine the effect of sector vulnerability on the size of CARs, we define a dummy variable V_i that takes the value of one when the firm operates in a vulnerable sector, and zero otherwise. Nevertheless, as we have explained, nationalizations are a very special case of forced divestments, with a different impact on the size of CARs. Therefore,

Table 4.8: Traditional Methodology, Venezuela

Event type	CAR window				Events
	[0,0]	[0,5]	[-5,0]	[-5,5]	
Full sample	-1.07%	**-1.3315%***	-1.64%	-1.91%	63
Pre-expropriation warnings	-1.50%	**-3.0833%*****	**-1.9519%***	**-3.5378%*****	39
Ann. Nationaliz.	-0.27%	**0.7539%****	-0.62%	0.40%	23
Ann. Exprop.	-2.42%	-11.28%	7.01%	-1.86%	1
Occupation	0.11%	-1.87%	-0.87%	-2.84%	9
Threat	**-9.8691%*****	**-14.6068%*****	**-12.2875%***	**-17.0252%****	5
Transitory Revocation	n.d	-32.47%	-3.82%	-36.28%	1
Forced Divestments	-0.35%	1.50%	-1.15%	0.70%	24
Expropriations	**-1.1133%****	1.91%	-1.75%	1.28%	12
Forced Sales	0.10%	0.68%	0.91%	**1.4935%****	10
Permanent revocation	**1.6053%*****	3.32%	**-8.8030%***	-7.09%	2

Note: Cumulative abnormal returns from estimation of equation 4.1, excluding from the sample log returns with absolute value above 40%. Event window centered in the event date. Significance levels of 10%, 5%, and 1% are identified by *, **, and ***, respectively, and are based on the Generalized Rank T-test proposed by Kolari and Pynnonen (2011), using the asymptotic distribution of the test, and confirming these results by the means of its exact distribution.

Table 4.9: Alternative Methodology, Venezuela

Event type	CAR window				Events
	[0,0]	[0,5]	[-5,0]	[-5,5]	
Full sample	**-1.0896%***	-1.45%	**-1.6520%***	-2.03%	63
Pre-expropriation warnings	**-1.5412%***	**-3.2195%****	-1.96%	**-3.6797%****	39
Ann. Nationaliz.	-0.30%	0.66%	-0.62%	0.34%	23
Ann. Exprop.	**-2.3909%*****	**-11.7468%***	7.27%	-1.97%	1
Occupation	0.10%	-1.95%	-0.97%	**-3.0955%***	9
Threat	**-9.9917%***	**-15.3754%***	-11.64%	**-16.9337%***	5
Transitory Revocation	n.d.	**-37.6055%*****	-4.22%	**-38.8911%*****	1
Forced Divestments	-0.35%	1.45%	-1.15%	0.65%	24
Expropriations	-1.13%	1.86%	-1.56%	1.44%	12
Forced Sales	0.12%	0.59%	0.91%	1.41%	10
Permanent revocation	**1.6148%*****	3.43%	**-9.8811%***	-8.50%	2

Note: We calculate average CARs as $k\gamma_e$ from the estimation of equation 4.4, using Data Stream market index and robust standard errors. Significance levels of 10%, 5%, and 1% are identified by *, **, and ***, respectively, and are based on the largest between robust and cluster standard errors. We exclude from the sample log returns with absolute value above 40%.

we add a variable, N_i, that is equal to one if the event is a nationalization, and a variable NV_i, which is an interaction term between V_i and N_i. The model is presented in equation 4.5.

$$CAR_i = \beta_0 + \beta_1 N_i + \beta_2 V_i + \beta_3 NV_i + \epsilon_i \tag{4.5}$$

In principle, if the sector were vulnerable, one would expect investors to incorporate such information into their valuation, so that the reaction of stock prices is somewhat smaller when the event takes place. However, this may not be the case for nationalizations. To see why, remember that for forced sales, we expect (and find) CARs to be positive for this type of event because (i) there is a large uncertainty that gets resolved the day the firm agrees to the nationalization of its subsidiary, and (ii) nationalizations can be considered the lesser of two evils. Besides, the fact that a sector is vulnerable means that the government is fond of it. All this results in a lower success probability assigned to the positive outcome of a forced sale in a vulnerable sector than in one that is not vulnerable: when the nationalization is realized in a vulnerable sector, the market's reaction is stronger. This being said, we expect $\beta_1 < 0$, $\beta_2 > 0$, $\beta_3 > 0$.

The second and third columns of Table 4.10 present the results for equation 4.5 for the [0,0] and [0,5] windows. Abnormal returns on the event day have a positive and significant relationship with NV, which is the interaction between vulnerability and nationalization. The fact that $\beta_3 > 0$ implies that the market's reaction is much stronger for nationalizations carried out in vulnerable sectors, providing some support for our hypothesis.

However, besides sector vulnerability, the level of political risk of the host country may also explain the size of the response towards an expropriation related action. Investors can access different measures or proxies for political risk through either readily available indexes or, well, the news. To estimate the impact of this variable on the size of CARs, we use PRS Group's Regional

Table 4.10: CARs, vulnerability and political risk

	Vulnerability		Political risk	
Dep. Var.: CARs	**[0, 0]**	**[0, 5]**	**[0, 0]**	**[0, 5]**
N_i	-0.00006	-0.00267	-	-
V_i	-0.01258	0.00603	-	-
NV_i	**0.01903****	**0.05246***	-	-
P_i	-	-	-0.00053	-0.00009
NP_i	-	-	**0.00031*****	**0.00091****
Constant	-0.00387	**-0.02308*****	0.01095	-0.01485
R-squared	0.0216	0.0233	0.017	0.0183
n	**114**	114	112	112

Note: CARs obtained from estimating equation 4.1 constitute the dependent variable for all models in the table, using Huber-White robust standard errors.

Political Risk Index[26], which is free to access on PRS's website. The index represents an overall measure of risk for a given country, taking into account variables such as turmoil, expropriation, and other risks.

The idea behind the model presented in equation 4.6 is similar in spirit to that presented in the case of vulnerability. We would expect that if the event is a nationalization, the larger the level of political risk, the larger the CARs. This is because investors might have a perception that riskier countries are associated with a larger probability of the nationalization process ending in the catastrophic alternative of expropriation.

$$CAR_i = \delta_0 + \delta_1 P_i + \delta_2 NP_i + \epsilon_i \tag{4.6}$$

According to the columns (4) and (5) of Table 4.10, the only significant variable in regression (6) is the interaction term, and it has the expected sign. This supports the idea that resolved uncertainty for nationalizations occurring in an already rather uncertain environment triggers a positive response from the market.

4.7 Final remarks

Events related to expropriations are likely to generate a reaction in stock returns since shareholders risk losing their stake in the expropriated firm without receiving a proper compensation. We define expropriations, following Truitt (1970), as those events where the sovereign seizes privately owned tangible property. However, through an extensive investigation on expropriation events, we find that there may be several types of actions related to the deed of expropriation. We divide these actions between pre-expropriation warnings (announcements of expropriations, nationalizations, occupations, threats, and transitory permit revocations), which do not necessarily imply asset seizing by the government, and the actual event of forced divestments (forced sales, outright expropriations, and permanent permit rescissions), where the firm losses/cedes property or control rights on its business in the expropriating country.

In order to determine whether these events actually have an impact on the value of the parent firm, we conduct an event study using a novel data set. In general, as expected, we find that most expropriation related events are associated with a value loss for the parent firm shareholders; among these, events associated with permit revocations are the ones that generate the largest negative market reaction among the events in our sample. A rather unexpected finding is that outright expropriations do not appear to be a negative surprise for the market, since we do not find any significant abnormal returns associated with them. One possible explanation is that only five of the expropriations in our sample were unannounced.

Nevertheless, when it comes to forced sales, we no longer expect it to be a negative announcement for the parent firm, unlike the approach observed in the extant literature. We hypothesize

[26]The index, calculated annually, is available for several years at https://www.prsgroup.com/category/risk-index. The original series decreases with political risk, but we rescale it to reflect a larger value as political risk grows, just to make interpretation a bit easier.

that forced sales may be seen as a rather positive event by the market. This is because in lieu of the alternative of having its assets seized by the host government, the parent firm locks in a deal to transfer its assets for a stipulated price, resembling a regular asset sale. When we analyze the data, we find a consistent positive reaction of the market towards forced sales, which is a novel result, as far as we know.

When we analyze the results separating Venezuela from the rest of the world, we find that the market interprets any pre-expropriation warning as a credible threat and tends to react vigorously whenever the government signals the intention to expropriate. As for the rest of the world, results for forced sales suggest anticipation and learning, indicating possible information leakages on the side of the parent firm. However, warnings do not seem to alarm investors, suggesting that they are not necessarily taken seriously if the country is other than Venezuela.

The cross-section of CARs suggests that these are explained to some extent by political risk and sector vulnerability to expropriation. Particularly, our results suggest that nationalizations are considered more positively than usual whenever the firm operates in a vulnerable sector or in a high political risk country.

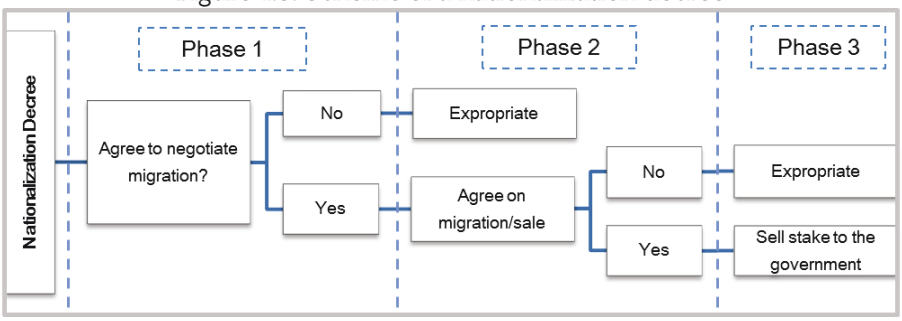
Further research could use this dataset to study the reaction of parent firms' debt when a subsidiary is affected by a governmental action that signals forced divestments, since debtors have different incentives than shareholders. It can also be used to study more accurately determinants of expropriations, as well as to analyze the impact of expropriations on sovereign risk.

4.8 Appendices

Appendix A: Example of a Nationalization Decree

In order to illustrate the process of nationalization, we take the case of Venezuela, which we outline in Fig. A1. In general, a nationalization process has two phases: the negotiation of terms and conditions under which control/stock transfer is going to be executed (phase 2) and, when appropriate, the sale of stake to the government (phase 3). In the figure, Phase 1 refers to two special nationalization cases in Venezuela's hydrocarbons sector: firms had to decide at this stage whether they agreed to be taken into account for planning the migration from private to mixed enterprises.

Figure 4.5: Scheme of a nationalization decree



Appendix B: Preliminary sample

Before checking for the existence of confounding events in our sample, we found that 71 firms were affected by expropriation-related announcements 208 times (Table B1). These events occurred in 12 countries, with Venezuela and Bolivia accounting for nearly 51% and 14% of them, respectively.

Table 4.11: Frequency of events by type

Event type	Frequency	Percent
Announcement of nationalization	58	27.88%
Announcement of expropriation	5	2.40%
Occupation	19	9.13%
Threat	47	22.60%
Contract revoked or end of concession	12	5.77%
Pre-Expropriation Warnings	**141**	**67.79%**
Outright expropriation	31	14.90%
Forced sale	30	14.42%
Permanent Rescission of Contract	6	2.88%
Forced Divestment	**67**	**32.21%**
Total sample	**208**	**100.00%**

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